Initial Groundwater Management Plan for the Santee-Lynches Capacity Use Area

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Executive Summary

South Carolina's Groundwater Use and Reporting Act (Chapter 5, Section 49-5-60) gives the South Carolina Department of Health and Environmental Control (SC DHEC) the legal authority and mandate to establish and implement a local groundwater management program in the designated Santee-Lynches Capacity Use Area (SLCUA).

Per the enabling legislation (Chapter 5, Section 49-5-20), "The General Assembly declares (Chapter 5, Section 49-5-20) that the general welfare and public interest require that the ground water resources of the State be put to beneficial use to the fullest extent to which they are capable, subject to reasonable regulation, in order to:

- Conserve and protect these resources,
- Prevent waste, and to
- Provide and maintain conditions which are conducive to the development and use of water resources."

Since hydrogeologic conditions and the relative socioeconomic requirements of the State vary by area and region, groundwater management should be locally and/or regionally assessed, balancing all needs and interests (more information on the SLCUA specifics and defining characteristics can be found in the Hydrogeologic Setting and Regional Description sections). In this regard, SC DHEC coordinates with local stakeholders to achieve the stated goals of the plan leading to sustainable use of the groundwater resources. Sustainable use is the key guiding principle, whereby South Carolina's groundwater resources are managed so that development meets present needs without compromising the ability of future generations to meet their needs.

Introduction

On July 15, 2021, the SC DHEC Board (section 49-5-60), declared portions south of the fall line in Chesterfield, Kershaw and Richland counties, along with Clarendon, Lee, and Sumter counties, as the Santee-Lynches Capacity Use Area (SLCUA) (Figure 1). The SLCUA is the sixth Capacity Use Area in the South Carolina coastal plain. Within the SLCUA, no person shall withdraw, obtain, or otherwise utilize groundwater at or in excess of three (3) million gallons in any month from a well or multiple wells for any purpose without first obtaining a Groundwater Withdrawal Permit from SC DHEC (R.61-113 C.)

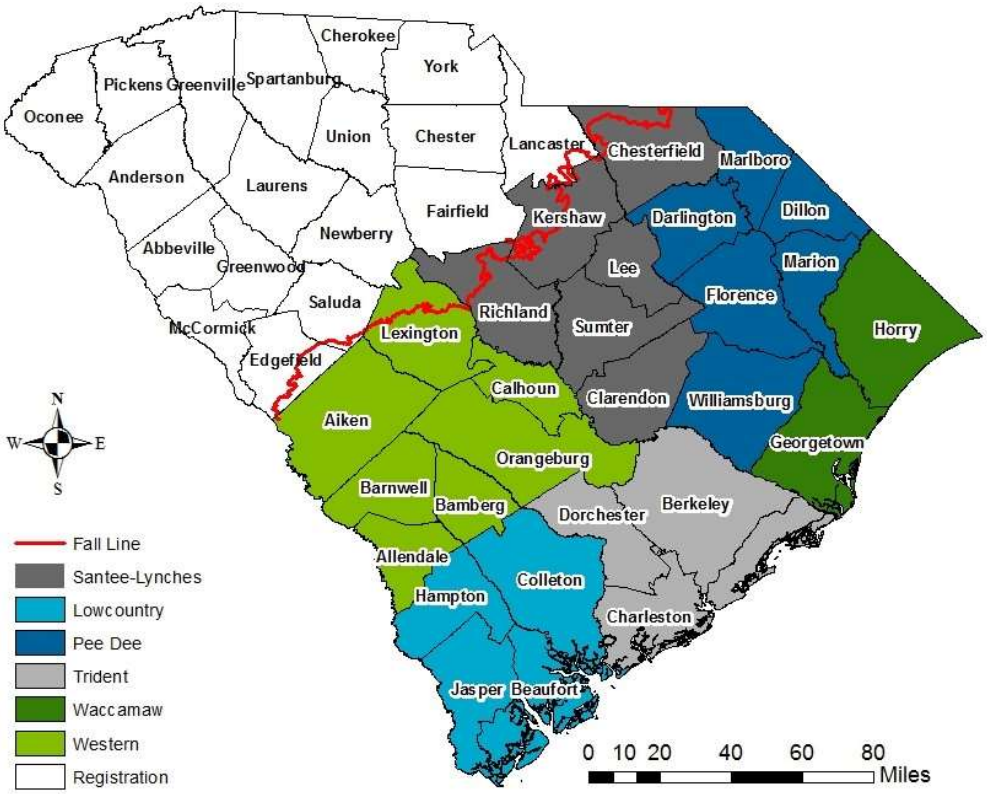


Figure 1: Capacity Use Areas and Associated Counties

The SLCUA Groundwater Management Plan (GMP) will guide the initial groundwater management strategy and provide direction for future groundwater management goals by evaluating, as data become available, the hydrologic, environmental, social, and economic impacts of groundwater withdrawals on long-term sustainable levels for SLCUA aquifers. Sustainable use meets present needs without compromising the ability of future generations to meet their needs and requirements. Therefore, in addition to the three statutory components of the Capacity Use program set forth in Chapter 5, Section 49-5-20, the three general goals of the GMP are:

1. Ensure sustainable use of the groundwater resource by management of groundwater withdrawals;
2. Monitor groundwater conditions to evaluate availability; and
3. Promote educational awareness of the resource and its conservation

To accomplish these goals, the GMP addresses the following aspects of water use in the Santee-Lynches region:

- Current groundwater sources utilized;
- Current water demand by type and amount used;
- Current aquifer storage and recovery and water reuse;
- Projected population and growth;
- Projected water demand;
- Projected opportunities for aquifer storage and recovery, as well as water reuse;
- Projected groundwater and surface water options; and,
- Water conservation measures.

Planning is a multi-stage process that includes provisions for updating and amending as conditions change over time. The first plan establishes general goals. As more data are developed about the groundwater resources of the SLCUA, more specific goals and withdrawal limits may be incorporated into the GMP. Modifications or updates to the goals and content of the GMP based on the quinquennial GMP Reports shall be made by SC DHEC authority or considered upon request by the SLCUA Stakeholder Workgroup.

Groundwater management is locally and regionally conducted to best fit an area's need andincorporates the acknowledgement of regional differences that necessitate varying strategies. Quantitative thresholds that activate a specific management action cannot be explicitly stated and established in any GMP to then be equally applied to all users across all counties in a CUA due to large variations in hydrogeologic setting and groundwater conditions. Instead, the GMP utilizes several management strategies in conjunction to abatepotential adverse effects, determine when certain management actions are necessary, and to adhere to the statutory framework as laid out in Chapter 5, Section 49-5-20.

Definitions

Adverse Effects: undesirable consequences of withdrawing groundwater that may include: changes in water quality, significant reduction in water level of the aquifer, saltwater intrusion, land subsidence, and decreases in stream flow

Aquifer Storage and Recovery (ASR): a process by which water is injected into an aquifer for storage and then subsequently withdrawn from the same aquifer from the same well or other nearby wells

Best Management Plan: a document that supports the design, installation, maintenance, and management of water conveyance systems and/or water withdrawal systems (water supply, commercial, industrial, agricultural, etc.), which promotes water conservation, and protects water quality

Farmland Acreage (USDA Definition): consists primarily of agricultural land used for crops,pasture, or grazing; including woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm producer's total operation

Groundwater User: a person using groundwater for any purpose

Groundwater Withdrawer: any person withdrawing groundwater at or in excess of three (3) million gallons during any one month from a single well or multiple wells within a one-mile radius of any existing or proposed well

Irrigated Acreage (USDA Definition): all land watered by any artificial or controlled means, such as sprinklers, flooding, furrows or ditches, subirrigation, and spreader dikes including supplemental, partial, and preplant irrigation

Person: an individual, firm, partnership, association, public or private institution, municipality or political subdivision, local, state, or federal government agency, department, or instrumentality, public water system, or a private or public corporation organized under the laws of this State or any other state or county

Physiographic Province: a region having a particular pattern of relief features or landforms that differs significantly from that of adjacent regions

Reasonable Use: the use of a specific amount of water without waste that is appropriateunder efficient practices to accomplish the purpose for which the appropriation is lawfully made

Stakeholder Workgroup: the SC DHEC designated committee, diverse in geographic and type-use representation, maintained as an advisory and collaborative partner concerning groundwater permitting, planning, education, and evaluation of the SLCUA

Sustainable Use: use of groundwater in a manner that can be maintained for an indefinitetime without causing adverse environmental, economic, or social consequences

Water Quality: chemical, physical, biological, and radiological characteristics of the water and measure of the condition of water relative to the intended use

Water Reuse: water that is recycled and used more than once and is treated to a standard that permits the intended beneficial reuse

Reasonable Use Determination by Water Use Type

SC DHEC establishes reasonable use of groundwater and develops limits depending on several factors, including, but not limited to the purpose(s) for which the water is withdrawn, application of type-based formulae, technical reviews of hydrogeologic conditions, groundwater use trends, demands on the resource, and availability of alternative sources of water. Each water use type has its own guidelines and standardized procedures in reasonable use determination (Table 1).

Water Use Type	General Reasonable Use Guidelines
Aquaculture (AQ)	Size of operation (acreage) Depth of holding ponds, lagoons, or lakes Refill rates
Golf Course (GC)	Based on current systematic and industry based standards Application rates Acreage irrigated Duration of irrigation
Industry (IN)	Based on current systematic and industry based standards Variable based on size and type of industry
Irrigation (IR)	Based on current systematic and industry based standards Crop type Irrigation method Acreage irrigated Duration of irrigation Stress period buffering
Mining (MI)	Based on current systematic and industry based standards Variable based on size and type of industry
Hydro Power (PH)	N/A
Thermo Power (PT)	Based on current systematic and industry based standards Availability of alternative water sources
Nuclear Power (PN)	Based on current systematic and industry based standards
Water Supply (WS)	Based on current systematic and industry based standards Population served Per capita use
Other (OT)	Variable based on size and type of operation Department approved Corrective Action Plans

Table 1: Generalized Water Quantity Permitting Section Reasonable Use Guidelines by Water Use Type

Geo-Political Structure

The State of South Carolina is divided into ten official planning districts under the South Carolina Association of Regional Councils (SCARC). Each district is referred to as a Council of Governments (COG). The purpose of the COGs is to provide a "uniform geographical framework within which the planning, programming, and delivery of services by state, federal, and local government might be undertaken with maximum efficiency and effectiveness." Three separate COGs operate within the SLCUA counties: Central Midlands Council of Government (CMCOG), Pee Dee Regional Council of Government (PDCOG), and Santee-Lynches Regional Council of Government (SLCOG).

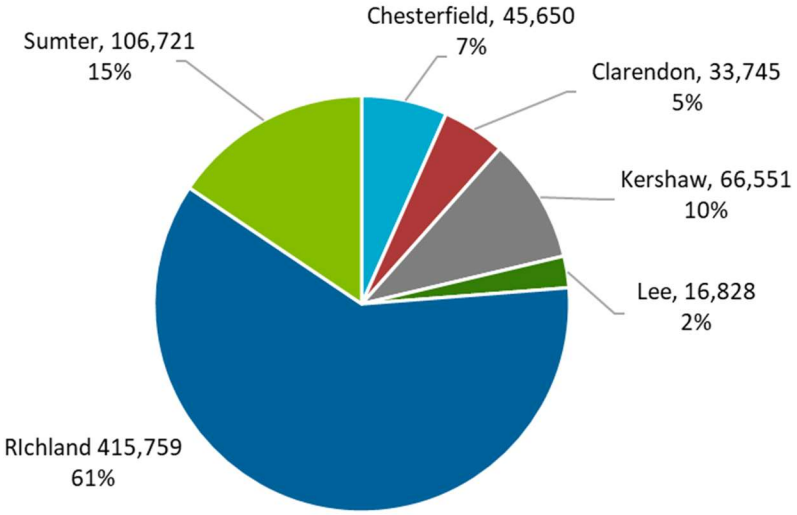


Figure 2: SLCUA Counties by Population

CMCOG governs one of the six counties in the SLCUA: Richland. CMCOG is currently governed by a Council-Administrator form of government that is made up of 51-members. CMCOG has incorporated 30 Municipalities and serves a total population of 775,296.

PDCOG governs one of the six counties in the SLCUA: Chesterfield. PDCOG is currently governed by a 27-member board appointed by County Councils in each of the six member counties PDCOG has incorporated 33 municipalities and serves a total population of 337,815.

SLCOG governs four of the six counties in the SLCUA: Clarendon, Lee, Kershaw, and Sumter. SLCOG is currently governed by a Council-Administrator form of government that is made up of 29 members. SLCOG has incorporated 12 municipalities and serves a total population of 223,845.

SC DHEC has permit authority for all groundwater withdrawals in the SLCUA that meet permitting requirements. Permits are issued after appropriate review in accordance with The Groundwater Use and Reporting Act, the Groundwater Use and Reporting Regulation, R.61-113, and the goals and management strategies developed in the GMP.

Hydrogeologic Setting

The Coastal Plain of South Carolina is part of the larger Atlantic Coastal Plain hydrogeologic system containing water-bearing, permeable sand or carbonate rock aquifers alternating with low-permeability confining units, usually consisting of clay or silt.

Aquifer Characteristics

The aquifers beneath the SLCUA are composed of sediments deposited during the late Cretaceous to Tertiary periods. From oldest to youngest, the Cretaceous units are the Gramling, Charleston, McQueen Branch, and Crouch Branch aquifers. The Tertiary unit is the Gordon, and Surficial aquifer is Quaternary in age (Figures 3-6). In the SLCUA, the confining units gradually thin and taper out to the northwest (geologically speaking, "up-dip"), causing the McQueen Branch and Crouch Branch aquifers to coalesce below Chesterfield County to form the Dublin-Midville Aquifer system. Below Richland and Kershaw Counties, the Crouch Branch Aquifer and surficial aquifer combine and ultimately pinch out at the Fall Line. As a result, the aquifers closest to the Fall Line are shallower, more interconnected, and show a greater degree of surface water interaction.

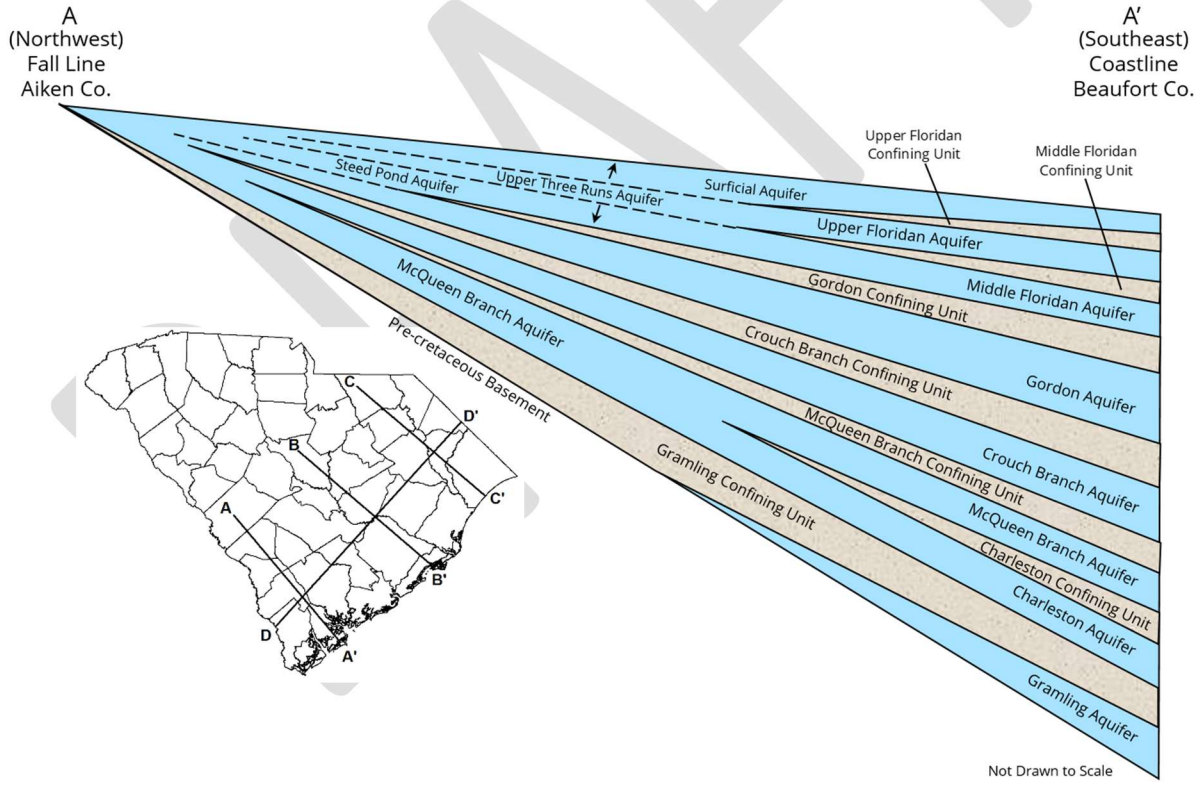


Figure 3: Generalized Cross Sections of South Carolina's Hydrogeologic Framework A – A'. Inset map shows the general locations of the cross-sections in Figures 3 – 6.

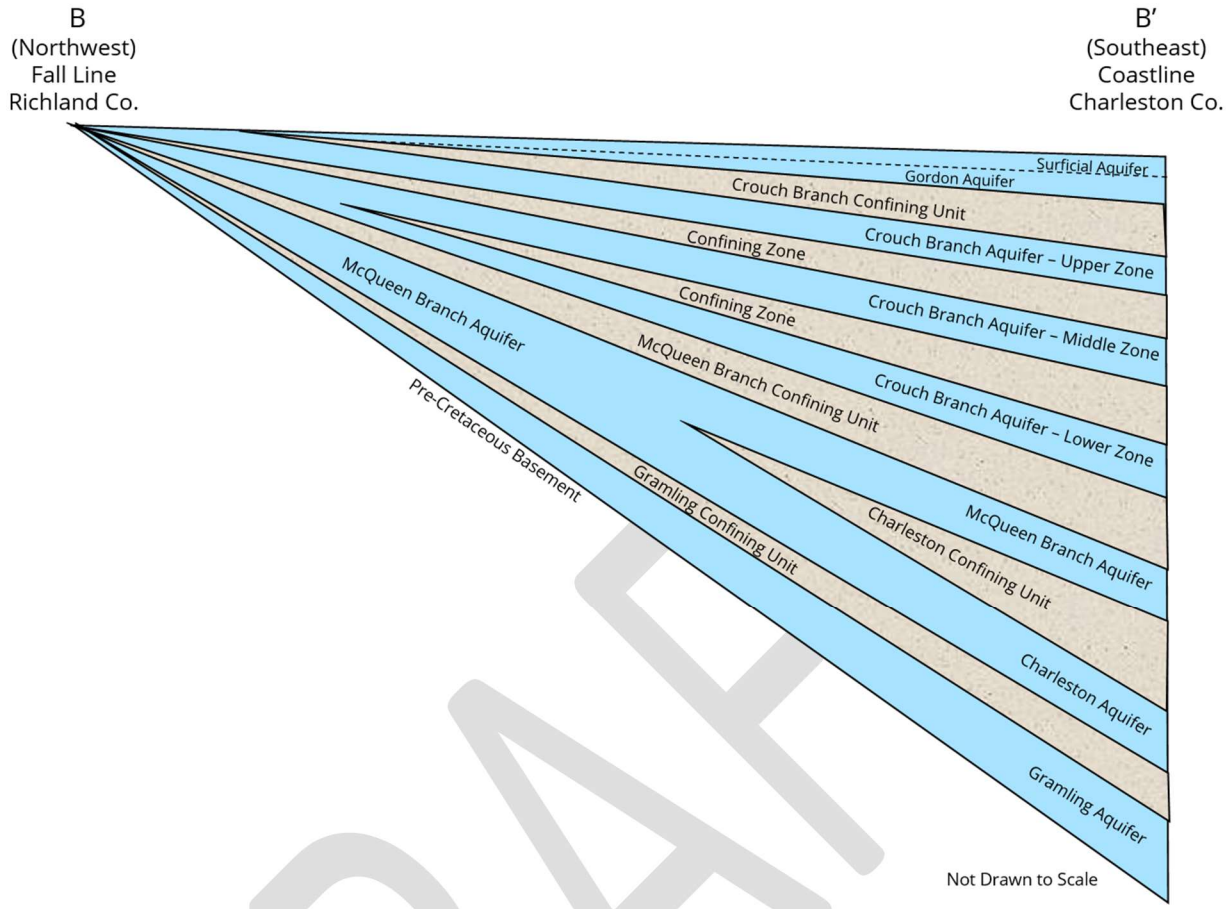


Figure 4: Generalized Cross Sections of South Carolina's Hydrogeologic Framework B – B' .

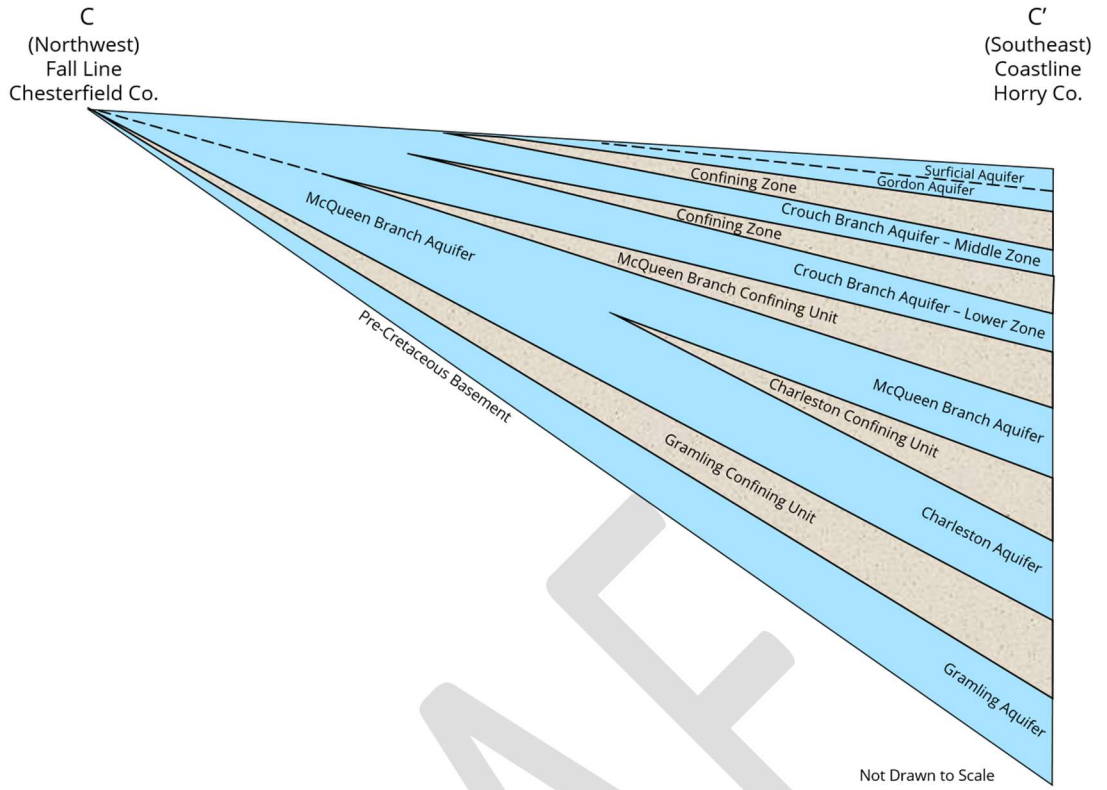


Figure 5: Generalized Cross Sections of South Carolina's Hydrogeologic Framework C – C' .

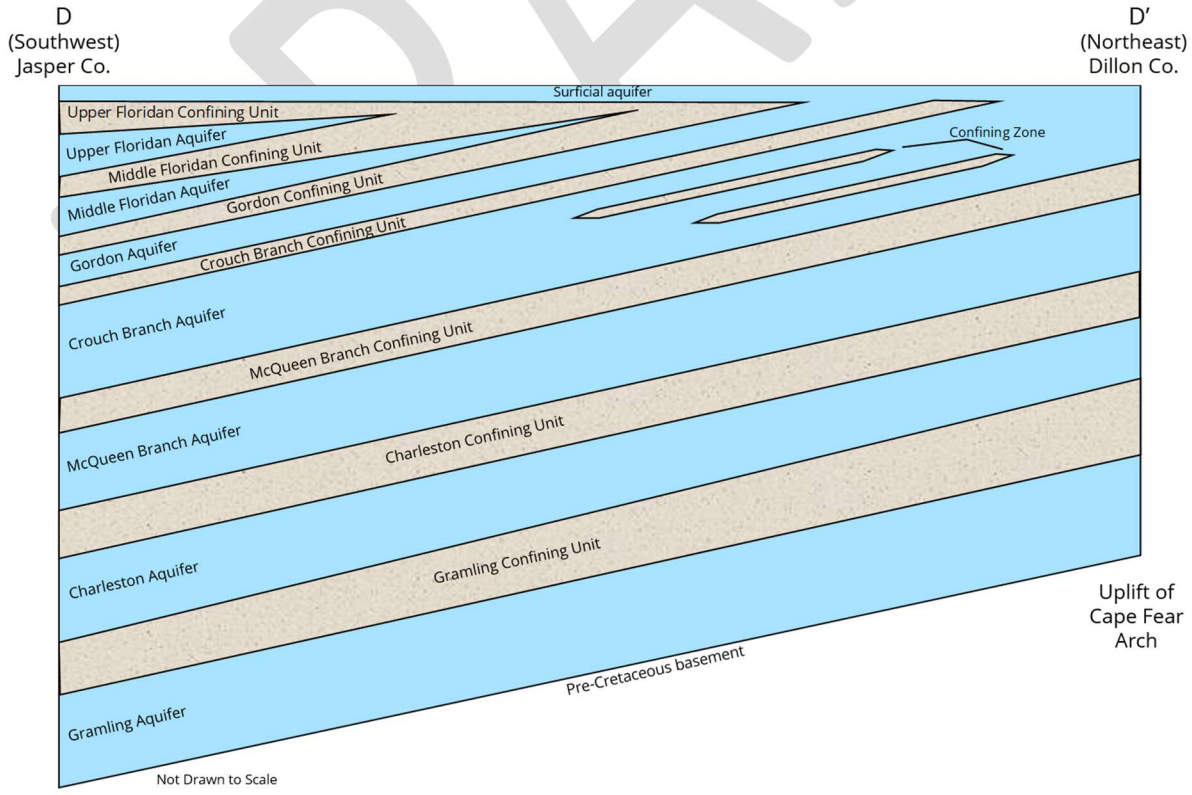


Figure 6: Generalized Cross Sections of South Carolina's Hydrogeologic Framework D – D' .

Aquifer Recharge

The recharge areas for the state's major aquifers are generally within the Inner Coastal Plain, an exception being surficial aquifers, which are recharged locally (Figure 7). Aquifers extending all the way to the coast are dependent on precipitation infiltrating in the recharge areas in the northwestern Coastal Plain further "up-dip" to continuously replenish groundwater supply. Groundwater in the major aquifers is replenished primarily by infiltration in the Inner Coastal Plain that then permeates slowly towards the coast in the southeastern direction (geologically speaking, "down-dip"). Consequently, the rate at which groundwater is replenished in the aquifers is controlled by the rate at which groundwater travels from the recharge areas, closer to the Fall Line, to the coast. Typical groundwater flowrates for silts to well-sorted sands range from 0.003 to 300 feet per day. This means that once water becomes part of the groundwater system, it may take from a few years to tens of thousands of years to reach the deeper aquifers located along the coast.

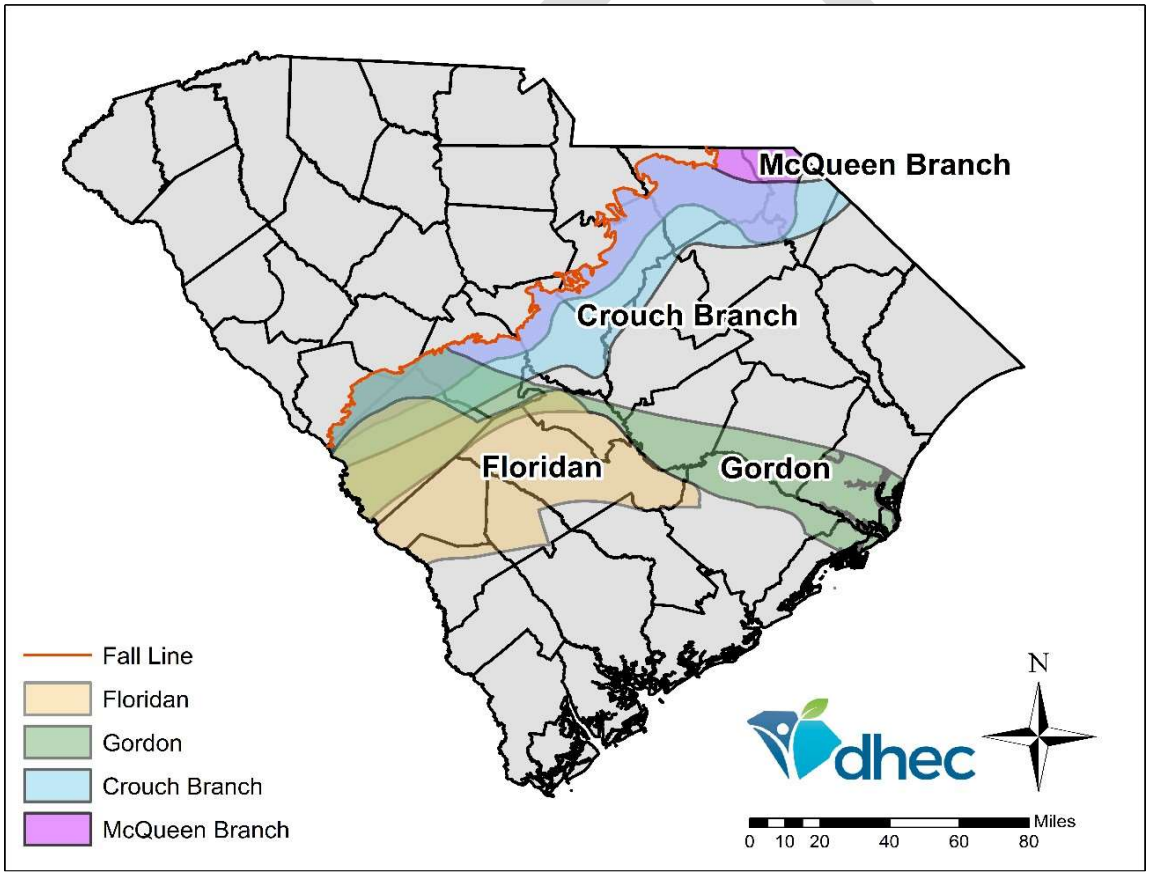


Figure 7: Major South Carolina Aquifer Recharge Area.

Water Budget

A water budget is a generalized accounting of all water that flows in and out of a given system. A water budget can be described with the following figure:

Inflow – Outflow = Change in Water Storage

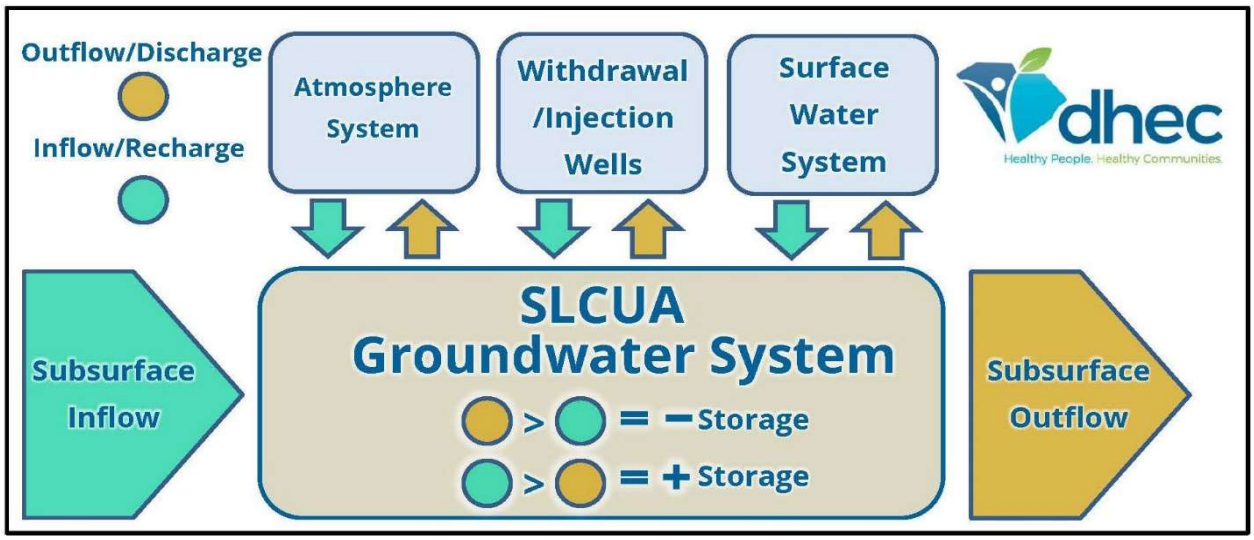


Figure 8: SLCUA Generalized Water Budget

When the sum of all outflow components is greater than the sum of all inflow, there is a decrease in storage within a groundwater system (Figure 8). Groundwater storage increases when the opposite is true: the sum of inflow is greater than the sum of outflow. Any change in the components of inflow and/or outflow affects the budget's equilibrium and the various fluxes in and out of the entire system.

In a typical year, South Carolina receives most of its water from precipitation, and the remainder is predominantly surface and subsurface inflow from neighboring states. A relatively small amount of the inflow is attributed to injection wells, which are used to abate adverse effects or provide back-up storage. Outflow from the state's water budget is almost entirely attributed to evapotranspiration and to surface water discharge into the ocean. A small amount of the outflow is aquifer discharge into the ocean, and an even smaller amount is due to water withdrawals.

South Carolina receives relatively large amounts of water. However, most water never infiltrates below the root zone into the deeper subsurface to function as groundwater storage. A significant portion of water is taken up by plants within the root zone or discharged into surface water systems before infiltrating deep enough to enter the groundwater system. Therefore, the amount of water that enters as groundwater storage is limited. Inflow into the groundwater system is also heavily dependent on when and where precipitation occurs. The portions of the state where water infiltrates into the aquifers are

known as recharge areas (Figure 7). Much of the SLCUA acts as a recharge area for confined aquifers that extend to the coast. Weather patterns vary from year to year, so the total volume of water that enters the system is not a static number. Precipitation during hot, summer months when evapotranspiration is at its highest, contributes significantly less to aquifer recharge than if that same amount of precipitation fell during cool, winter months when evapotranspiration is at its lowest.

Variations in inflow and outflow necessitate an adaptive management approach to using and conserving groundwater resources. A water budget is a valuable tool and provides relevant information regarding water resource availability and management; however, a statewide or CUA-wide water budget cannot be used and applied in determining individual permit decisions.

Regional Description

The counties in the SLCUA are in the mid-northern part of the state with Chesterfield County bordering North Carolina and Clarendon County bordering Berkeley County to the south (Figure 1). The SLCUA comprises six counties that cover 4,104 mi^2 : Chesterfield, Clarendon, Kershaw, Lee, Richland, and Sumter. The largest of the counties, Chesterfield, covers approximately 805 mi^2 (19.6%), Clarendon covers approximately 698 mi^2 (16.9%), Kershaw covers approximately 740 mi^2 (18%), Lee covers approximately 411 mi^2 (10%), Richland covers approximately 771 mi^2 (18.8%), and Sumter covers approximately 682 mi^2 (16.6%). Roughly 159 mi^2 (3.8%) of the SLCUA is surface water coverage, and 65% of that area is major lakes. Lee County encompasses the least amount of surface water coverage with 0.82 mi^2 (0.5%) and Clarendon County encompasses the most amount of surface water coverage with 88 mi^2 (55%) of SLCUA's total surface water.

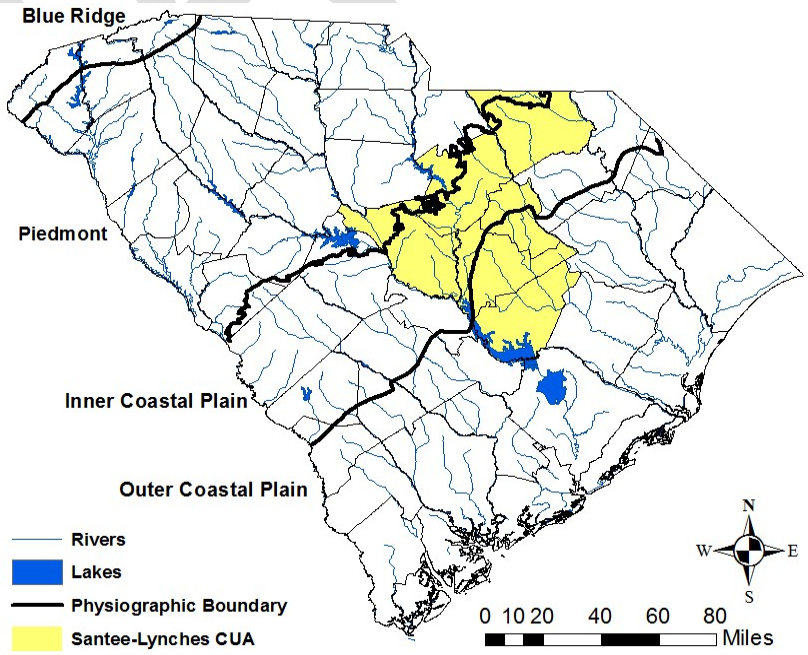


Figure 9: Physiographic Provinces of South Carolina and Major Water

The SLCUA extends 93 miles from north to south and 84 miles in west to east directions. The six SLCUA counties are diverse in physiography and hydrology resulting from their areal extent within the state. From the northernmost county of Chesterfield to the southernmost county of Clarendon, the SLCUA spans three of the four physiographic provinces (Figure 9). Chesterfield, Kershaw, and Richland Counties cross the Fall Line with portions in the Piedmont and Inner Coastal Plain. Lee and Sumter Counties are divided between the Inner and Outer Coastal Plains, and Clarendon County is entirely within the Outer Coastal Plain.

Surface Water

The SLCUA is drained by five of the eight major river basins in the northeastern half of the state—the Broad, Catawba, Pee Dee, Saluda, and Santee Basins (Figure 10). Major rivers that pass through or define county boundaries are the Black, Broad, Congaree, Little Lynches, Little River, Lynches, Pee Dee, Saluda, Santee, and the Wateree Rivers. Major lakes in South Carolina are formed by dammed river systems, and the major lakes in the SLCUA include Lake Wateree, Lake Murray, Lake Robinson, and Lake Marion. Surface water bodies incise and interact heavily with aquifer systems within the region, especially closest to the Fall Line (Figure 11). In some cases, the incised valleys isolate water-bearing units from the greater regional aquifer(s) (Figure 11). The interconnectivity of surface and groundwater in the SLCUA is a defining regional characteristic, particularly within the Inner Coastal Plain.

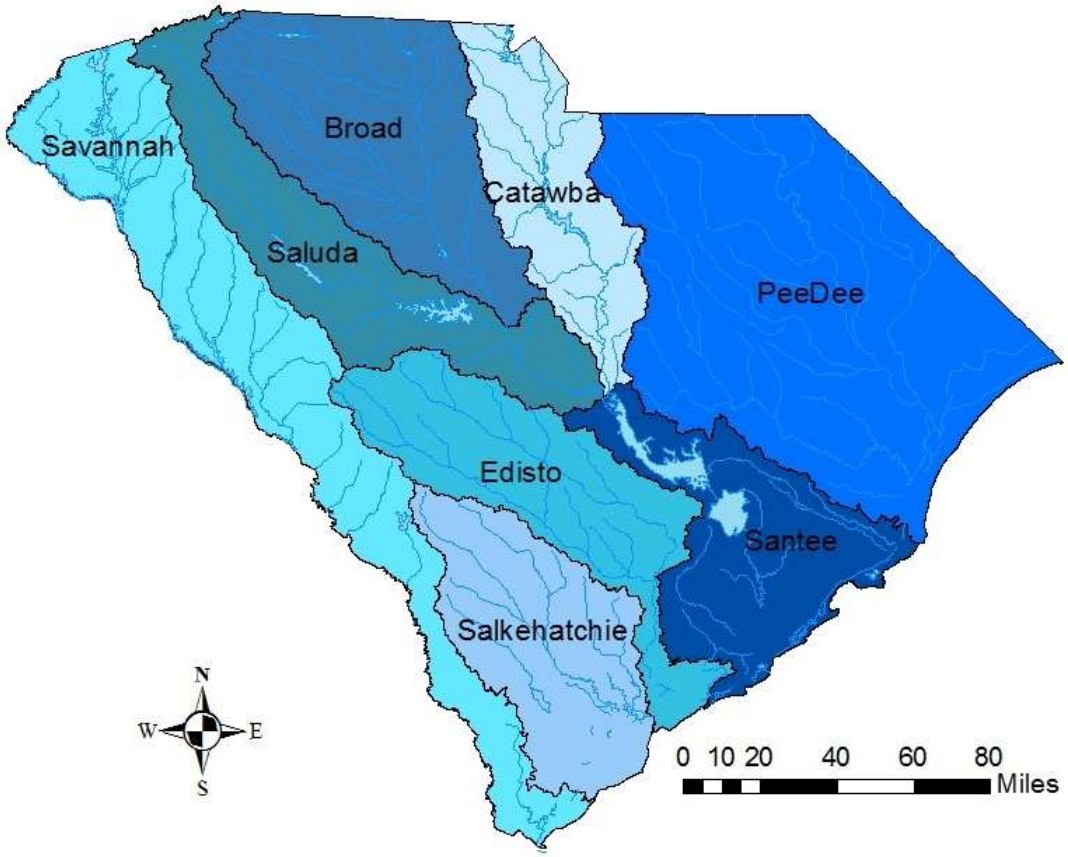


Figure 10: Major River Basins for South Carolina.

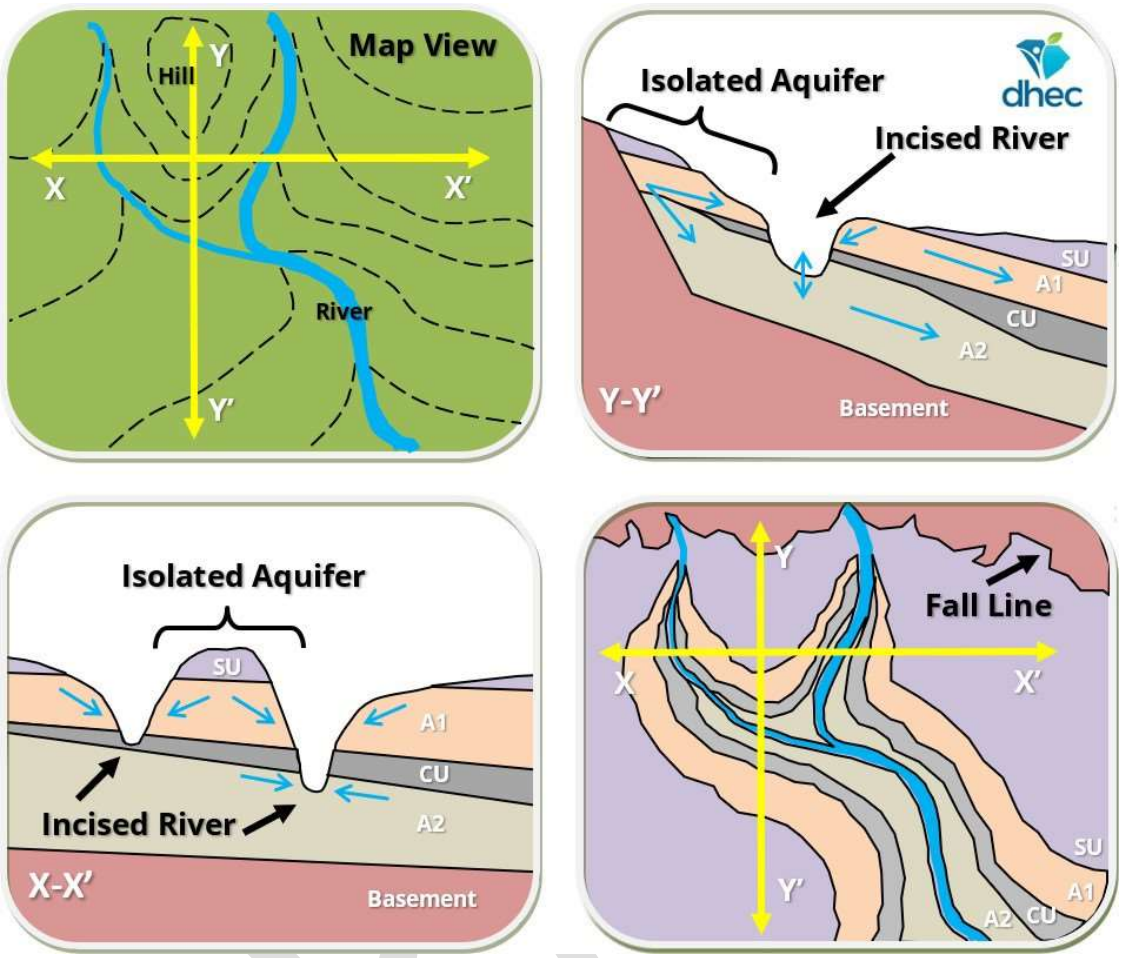


Figure 11: Isolated Aquifer Diagram (Top Left: Map View with Lines of Elevation; Top Right: Y-Y' Cross Section; Bottom Left: X-X' Cross Section; Bottom Right: Map View Showing Surface Exposure of Hydrogeologic Units) (SU=Surface Unit; A1=Aquifer 1; CU=Confining Unit

Topography and Geology

The topography varies across these counties from the low-relief Outer Coastal Plain through the gently rolling hills of the sandhills region (part of the upper coastal plain at the Fall Line; see the Physiography and Hydrology Section). The total elevation ranges from 25 to 720 feet above mean sea level (AMSL). Several hard rock outcrops expose underlying granitic and gneissic bedrock of the Piedmont along the Fall Line. Traveling seaward, the topography transitions from undulating hills incised by steams and valley in to low-relief plains with meandering rivers. The higher relief hills near the Fall Line are predominantly composed of micaceous and kaolinitic sands with clay lenses deposited from marine to marginal marine environments. The SLCUA is scattered with isolated wetlands known as Carolina bays, expansive floodplains, and cypress swamps.

Climate

The SLCUA, much like the entire southeastern United States, is characterized as a sub-tropical climate. The SLCUA experiences warm, humid summers and mild winters. Proximity to the lower Appalachian Mountains and the Atlantic Ocean considerably affects the regional climate. The middle portion of the state is warmer and receives less rainfall than other areas of South Carolina. The SLCUA does not receive as much of the cooling effects associated with the higher altitudes of the upstate or from the ocean breezes of the coast. Furthermore, the area is too far inland to be significantly influenced by coastal storm cells and is too far from the mountains to be influenced by the temperate rainforest conditions of the lower Appalachians. On average, the SLCUA receives 46.62 inches of precipitation annually (Figure 12). The average annual temperature of the six-county area from 1991-2020 is 63.18°F with normal maximum and minimum average annual temperatures of 74.76°F and 51.63°F (Figure 12).

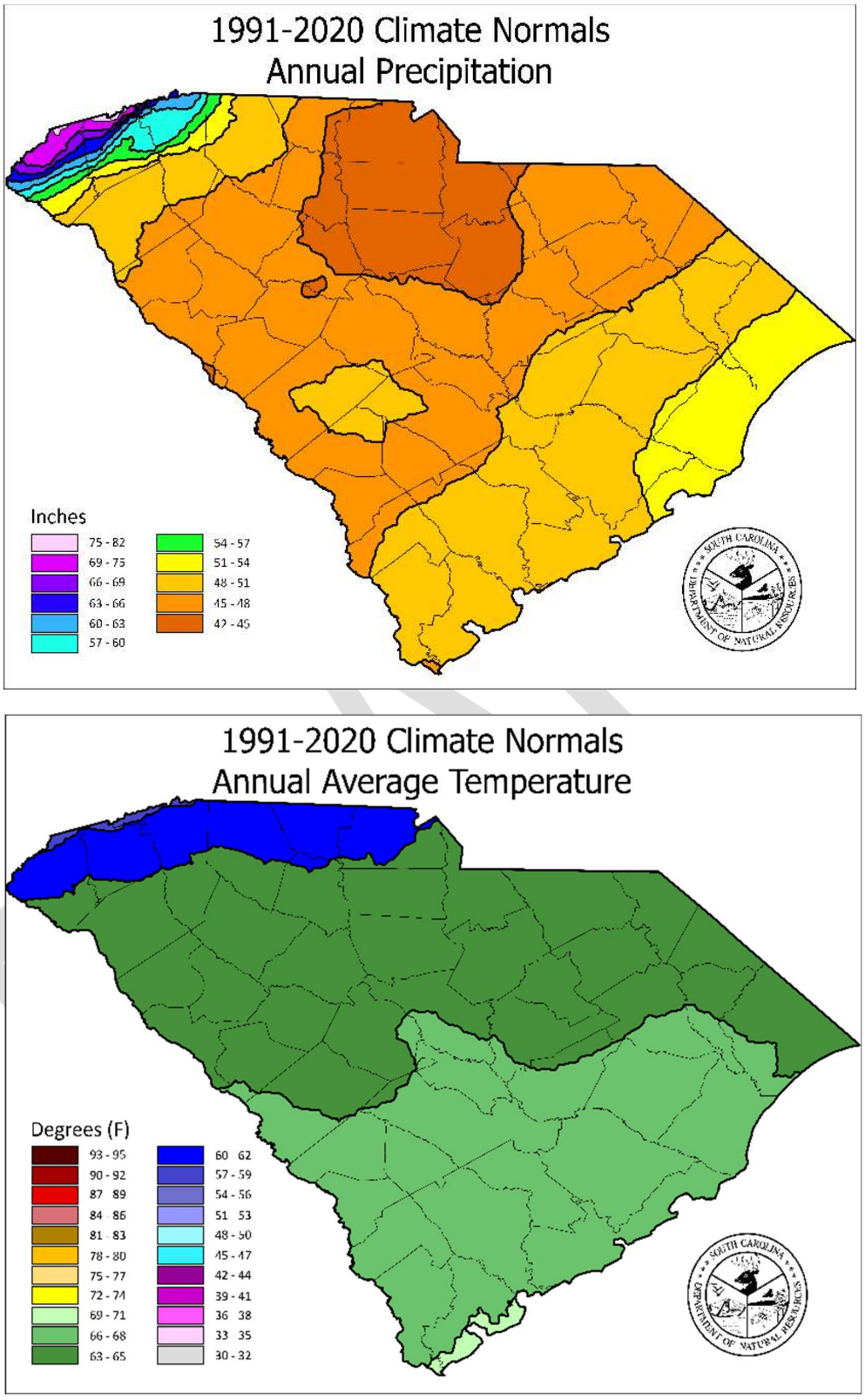


Figure 12: Climate Normals (1991-2020) (Top: Annual Average Precipitation, Bottom: Annual Average Temperature) Provided by SC DNR Climatology office at: https://www.dnr.sc.gov/climate/sco/ClimateData/cli_sc_climate.php#temperature

Climate has direct effects on South Carolina's aquifers, and the magnitude of those effects varies based on depth, location, and interconnectivity of the aquifers with the surface. Deeper aquifers are separated from the land surface by other aquifers and confining units, making them less susceptible to variations in climate patterns. Monitoring data demonstrate that groundwater levels rise during wetter periods and fall during drier periods. Figures 13 and 14 illustrate the impact that climate variation can have on water levels. Lee-0075 is believed to have minimal impacts from nearby pumping and therefore, represents how the water levels in the Inner Coastal Plain respond to changes in recharge.

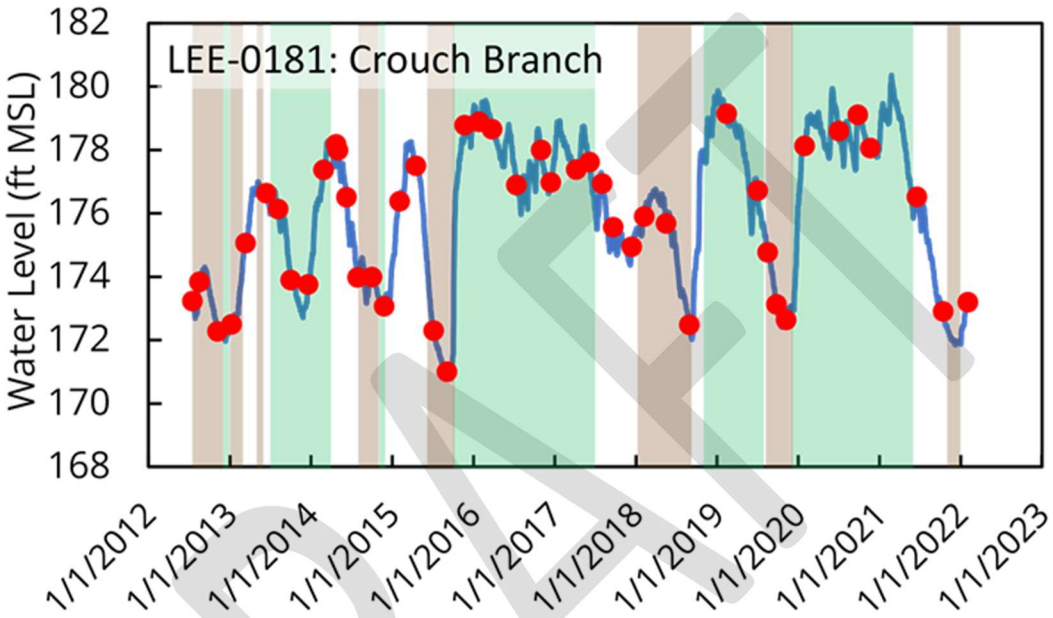


Figure 13: Climate Impact on Groundwater Levels (Brown is Drier and Green is Wetter) LEE-0181 Crouch Branch.

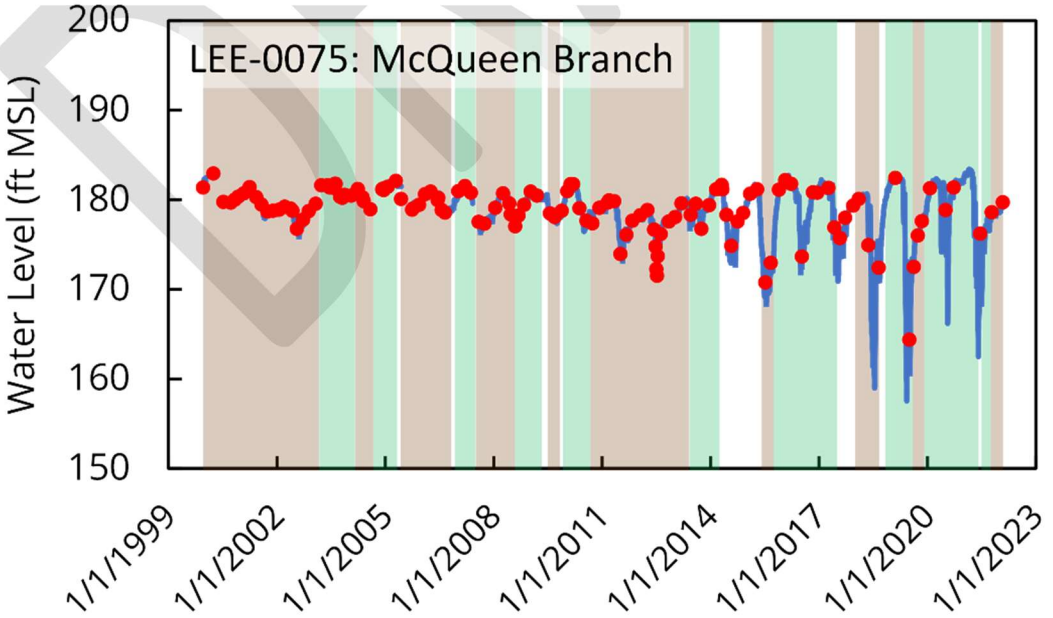


Figure 14: Climate Impact on Groundwater Levels (Brown is Drier and Green is Wetter) LEE-0075 McQueen Branch

Land Cover

The SLCUA is a diverse portion of the state with intermediate regions of urban landcover, cultivated croplands, and mixed deciduous and evergreen forest. Most urban coverage is concentrated in eastern Richland County, central Sumter County, and lower Kershaw County running northeast through Elgin, Lugoff, and Camden. Cultivated cropland covers a significant portion of Lee, Sumter, and Clarendon Counties (Figure 15).

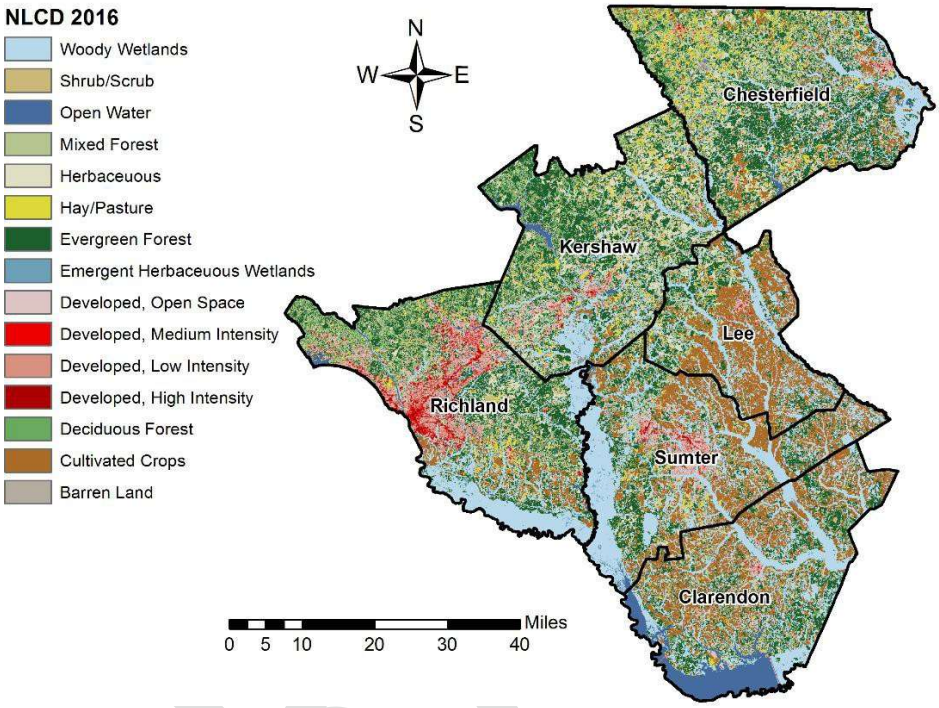


Figure 15: Land Cover from the National Land Cover Database from 2016. Multi-Resolution Land Characteristics Consortium; https://mrlc.gov; accessed February 28, 2020.

Per the latest USDA Census of Agriculture (2017), about one-third (761,771 acres) of the land cover within the SLCUA is used for farmland operations (Figure 16). Overall, there was a 12% increase in reported farmland operational use since 2002; however, the growth varied across the region. While Clarendon, Kershaw, Lee, and Sumter Counties reported increases, Chesterfield and Richland Counties reported declines (Figure 16).

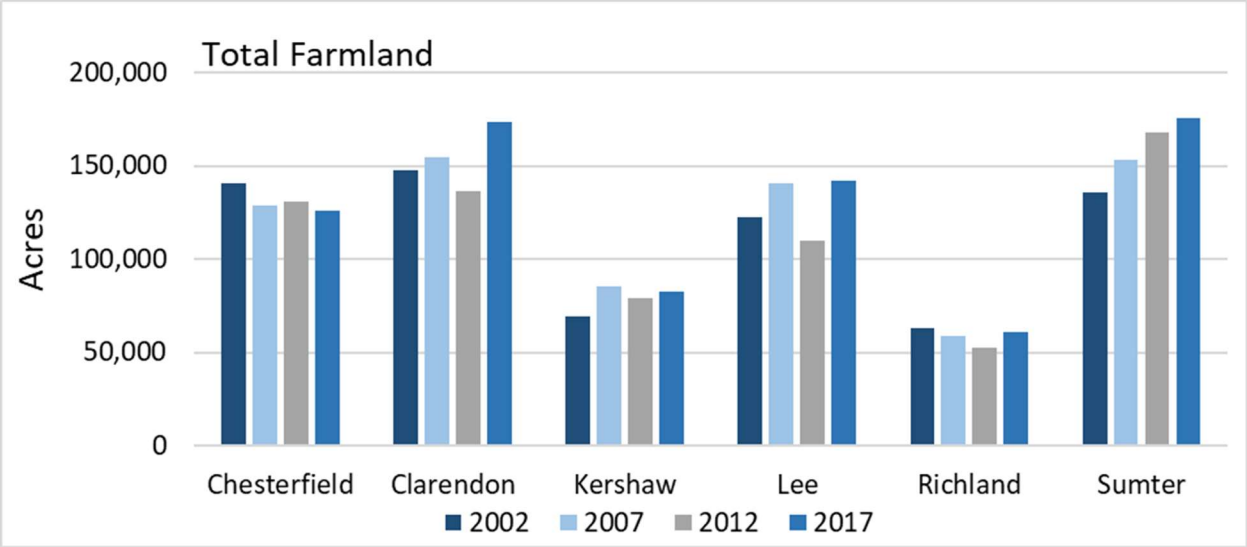


Figure 16: Total Farmland Acreage by SLCUA County (USDA, 2002-2017)

During the period of 2002 to 2017, agricultural harvested cropland acreage reported to the USDA increased by 24.6%. All six counties reported increases in harvested cropland. Total reported harvested cropland acreage in 2017 was 309,186 acres (Figure 17).

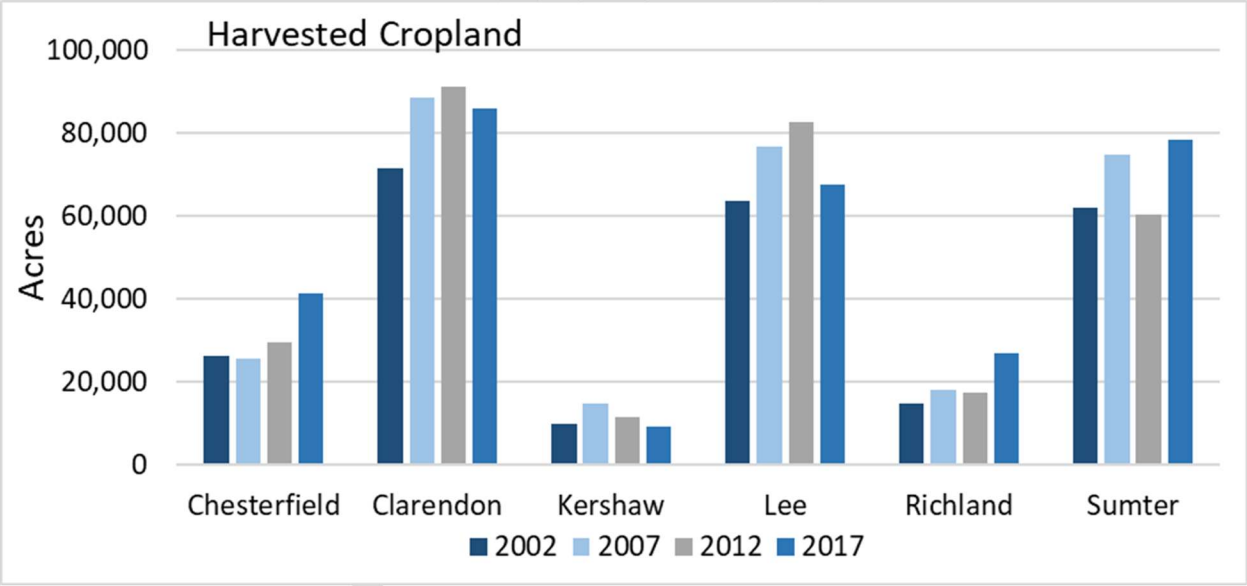


Figure 17: Harvested Cropland Acreage by SLCUA County (USDA, 2002-2017)

Irrigated acreage within the SLCUA, as reported to the USDA, increased 328.7% during the period 2002 to 2017. Five of the six counties reported increases in irrigated acreage, the exception being Kershaw which reported decreases since 2012. Total reported irrigated acreage in 2017 was 47,167 acres (Figure 18).

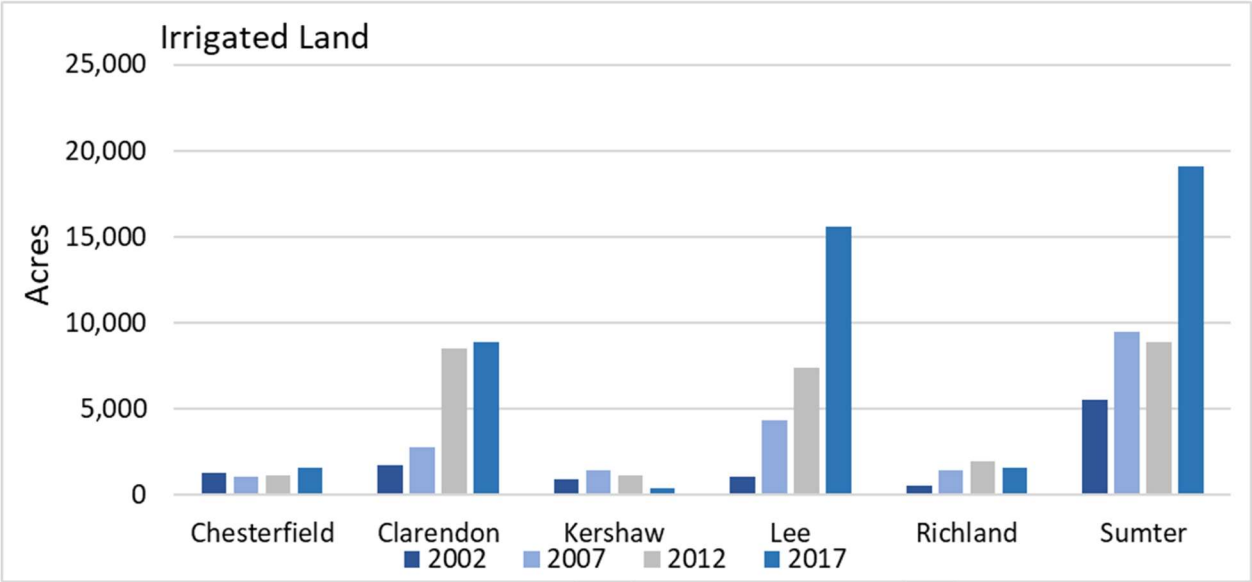


Figure 18: Irrigated Acreage by SLCUA County (USDA, 2002-2017)

Groundwater Trends

A detailed review of groundwater trends in the six SLCUA counties may be found in the initial assessment. Seasonal water level declines associated with increased water use during the summer months are apparent in many of the water-level records. Long term declines shown in the monitoring network and the potentiometric maps suggest that groundwater withdrawal rates from the Crouch Branch and McQueen Branch aquifers exceed the rate at which they recharge. A map of the SC DNR Groundwater Monitoring Network wells along with the most current water level records for selected wells within the SLCUA may be found in Appendix A.

SC DNR has prepared potentiometric surface maps of the Coastal Plain aquifers of South Carolina since the 1980s. Appendix B contains a subset of these maps in the SLCUA for the major aquifers. Data is represented as pre-development compared to the most recent potentiometric surface measured in each aquifer. Groundwater flow within both major aquifers is generally to the southeast. There have been no major cones of depression apparent in the six counties.

Current Groundwater Demand

There are currently 530 wells registered in the SLCUA (Table 2). Within the ten (10) water use categories, Irrigation has the greatest number of wells with 298, and among the six (6) counties, Sumter County has the greatest number with 157 wells.

Water Use Category	Chesterfield	Clarendon	Kershaw	Lee	Richland	Sumter	Totals
Aquaculture (AQ)	0	1	0	0	1	0	**2**
Golf Course (GC)	0	3	1	0	18	4	**26**
Industry (IN)	1	0	41	0	3	17	**62**
Irrigation (IR)	17	69	8	100	17	87	**298**
Mining (MI)	0	0	0	0	0	0	**0**
Other (OT)	0	0	0	0	0	0	**0**
Power Thermo (PT)	0	0	0	0	0	0	**0**
Power Hydro (PH)	0	0	0	0	0	0	**0**
Power Nuclear (PN)	0	0	0	0	0	0	**0**
Water Supply (WS)	18	26	32	7	10	49	**142**
Totals	**36**	**99**	**82**	**107**	**49**	**157**	**530**

Table 2: SLCUA: Current Number of Registered Wells by Type Use Category and County, 2020

Water Use Category MG	Chesterfield	Clarendon	Kershaw	Lee	Richland	Sumter	Totals (Percent)
Aquaculture	0	0	0	0	17	0	17 (0.1%)
Golf Course	0	9	2	0	40	35	86 (0.5%)
Industry	1	0	653	0	733	156	1,544 (9.6%)
Irrigation	242	1099	109	1520	284	1973	5,228 (32.6%)
Mining	0	0	0	0	0	0	0 (0.0%)
Other	0	0	0	0	0	0	0 (0.0%)
Power Thermo	0	0	0	0	0	0	0 (0.0%)
Power Hydro	0	0	0	0	0	0	0 (0.0%)
Power Nuclear	0	0	0	0	0	0	0 (0.0%)
Water Supply	1,105	692	787	572	484	5,542	9,182 (57.2%)
Totals (Percent)	1,348 (8.4%)	1,800 (11.2%)	1,552 (9.7%)	2,092 (13.0%)	1,558 (9.7%)	7,706 (48.0%)	16,056 (100%)

Table 3: SLCUA: Reported Water Use by Type Use Category and County, 2020

Water use reported for 2020 totaled 16,056 million gallons (MG) (Table 3). Sumter County reported the highest total water use comprising 48%, and Chesterfield County reported the least at 8.4%. The majority of reported water use was for water supply (57.2%), followed by irrigation (32.6%), industry (9.6%), golf course (0.5%), and aquaculture (0.1%). Monthly reported water use for 2020 shows the seasonality is inherent in irrigation, which increases during the spring months and peaks between May and August (Figure 19). Monthly reported water use for aquaculture, golf course, industry, and water supply remained comparatively constant during 2020.

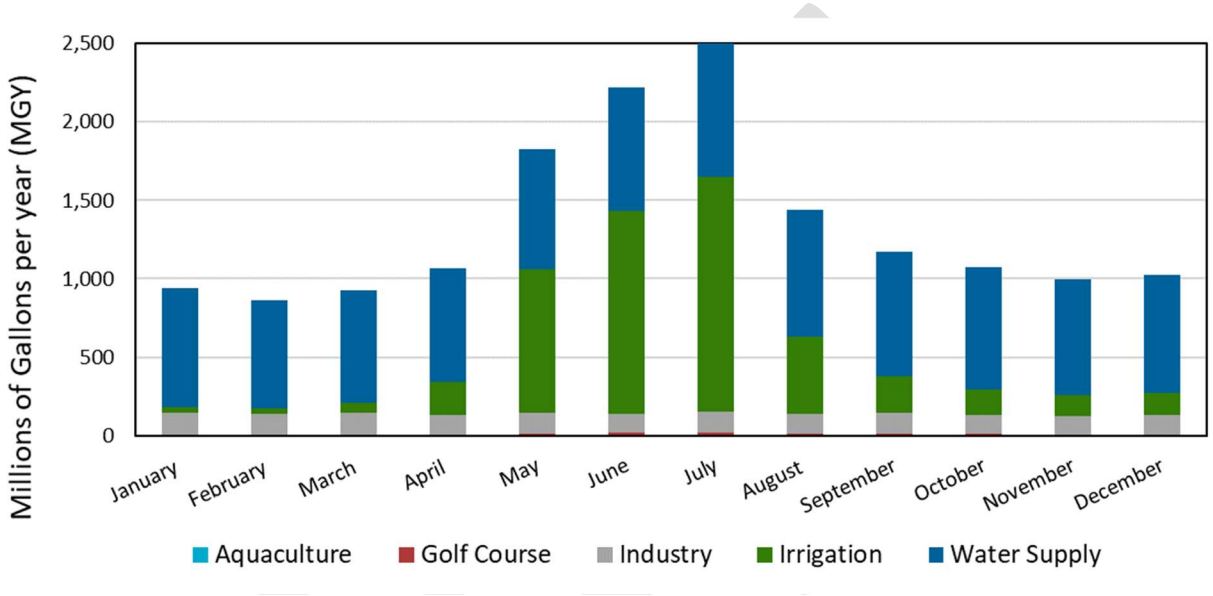


Figure 19: SLCUA: Reported Monthly Water Use by Category, 2020

Historic Water Demand

Water use reported between 2001 and 2020 by county and by use category are presented in Figures 20 and 21. Total reported water use remained relatively stable from 2001 through 2013. Beginning in 2013, reported water use began to increase, reaching a maximum of 19,116 MG in 2019. The majority of the increase was within the irrigation use category (Figure 21), as all other use categories remained relatively constant. In 2019, for the first-time irrigation water use surpassed water supply demand. In 2020 all type uses except for water supply had a decrease due to a high precipitation season.

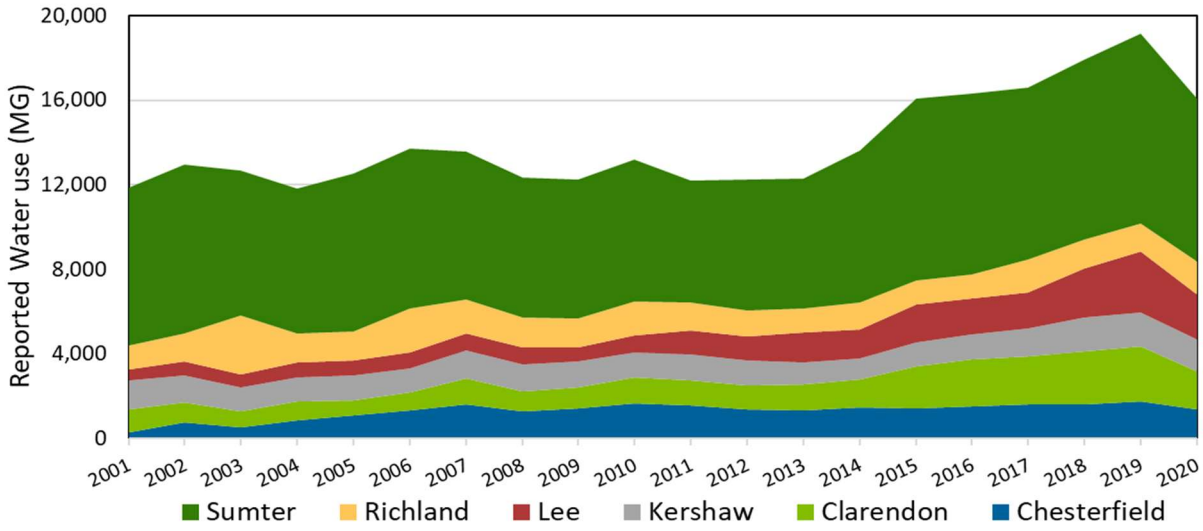


Figure 20: SLCUA: Reported Annual Water Use by County, 2001-2020

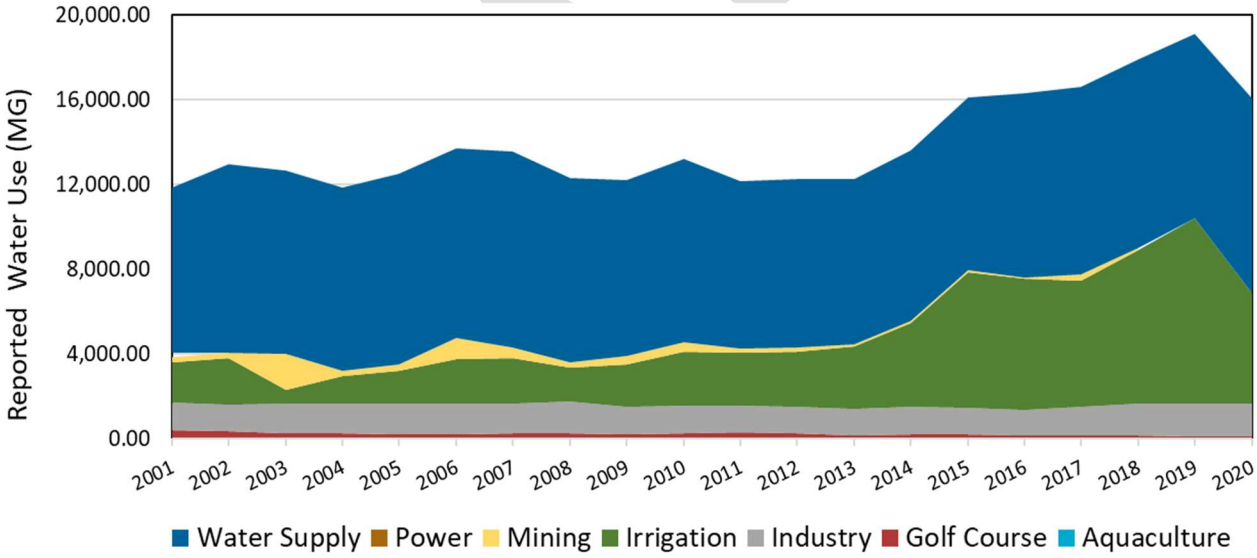


Figure 21: SLCUA: Reported Annual Water Use by Category, 2001-2020

During the same period, the total population in the SLCUA increased from 573,486 in 2000 to 685,254 in 2019 (Figure 22). This population change was the result of a large population increases in Richland County. Chesterfield, Clarendon, Kershaw, and Sumter experienced small increases in population while Lee County experienced a decline in population. Comparing the SLCUA counties' historic reported water use (Figure 20) with changes in population (Figure 22) suggests that the increase in reported water use cannot be explained by population changes alone.

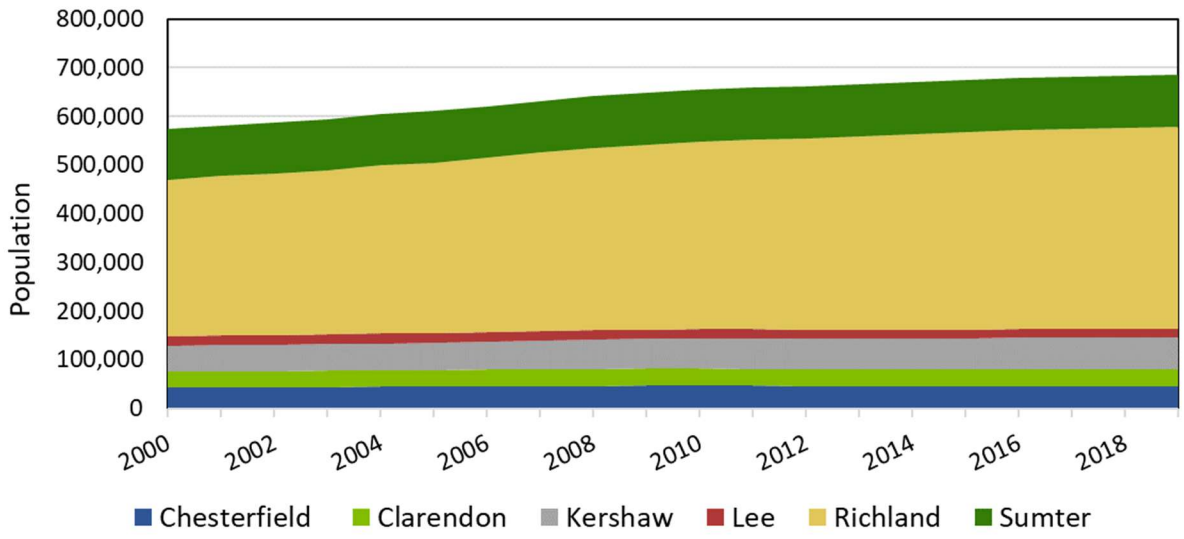


Figure 22: SLCUA: Population by County, 2001-2019 (US Census Bureau)

Santee-Lynches Area Irrigation

The observed increase in reported groundwater used for irrigation (Figure 21) may be the result of several factors including but not limited to: climate variations, greater number of irrigated acres (Figure 18) reported by the USDA, increases in water withdrawal per well, and number of irrigation wells in the SLCUA (Figures 23 and 24). From 2001 to 2020, both the number of reporting irrigation wells and reported water use increased at a similar rate (Figure 23). Rates of water use per well did not, however, follow the same pattern. In Figure 24, water use per well has deceased since its highest rate in 2001. This rate has fluctuated from year to year, but since 2015 water use per well has decreased, and the overall decrease from 2001 is likely due to improved farming techniques and more efficient irrigation methods and systems.

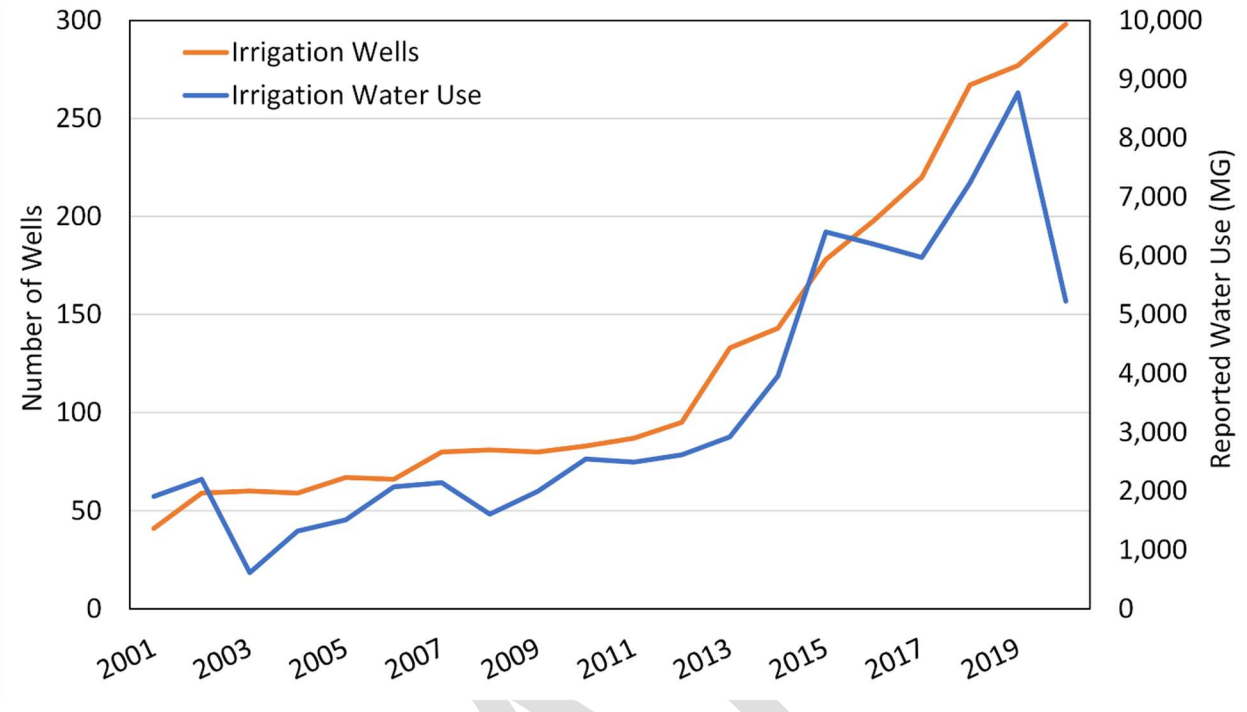


Figure 23: Number of Reporting Irrigation Wells and Reported Water Use for Irrigation from 2001-2020 for all SLCUA Counties

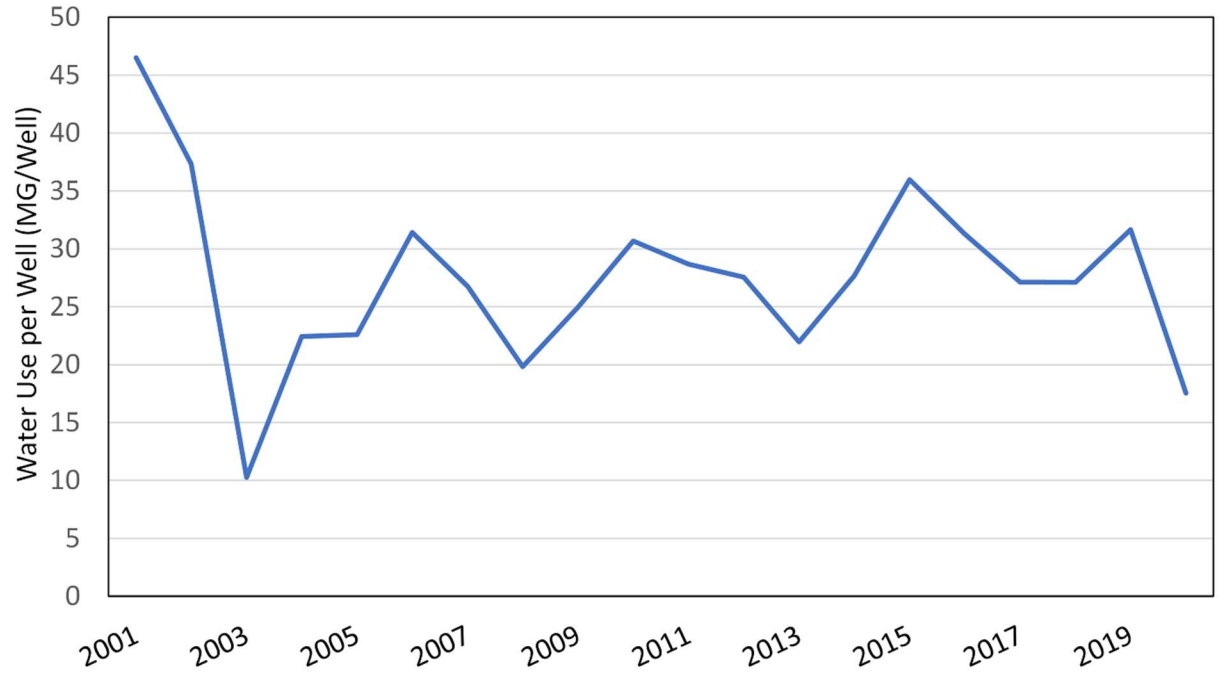


Figure 24: Reported Water Use Per Irrigation Well Reporting from 2001-2020 for all SLCUA Counties Calculated as Total Reported Water Use /Number of Reporting Wells

Groundwater Management Strategy

The GMP outlines a process to establish and implement a local groundwater management program in the SLCUA; the enabling legislation requires that the groundwater resources of the State be put to beneficial use to the fullest extent to which they are capable, subject to reasonable regulation, in order to conserve and protect these resources, prevent waste, and to provide and maintain conditions which are conducive to the development and use of water resources (Chapter 5, Section 49-5-20). In short, the goal is to develop and implement a sustainable use, adaptive-management strategy. Ultimately, SC DHEC will use all available scientific data that allow for informed permitting decisions and monitoring for potential adverse effects. The key strategies to achieve these goals are outlined below.

Strategy #1: Establish a Comprehensive Groundwater Monitoring Program

With increases in population and irrigated acreage, water demand (from both surface and groundwater) continues to grow steadily. Although water level declines are a normal response to groundwater withdrawals, not stabilizing these declines may cause serious impairment to the aquifers and groundwater quality of the region. SC DHEC will pursue partnerships with local entities, groundwater users, and other agencies (both Federal and State) to facilitate the most effective use of resources in designing and maintaining a monitoring network for the SLCUA. SC DNR, USGS, and private entities maintain several groundwater level monitoring locations in the SLCUA.

Although the SLCUA has 30 groundwater monitoring wells maintained by SC DNR, expanding the current network will allow more accurate monitoring of groundwater level conditions and facilitate science-based recommendations for strategies to address any stressed aquifer conditions in the area (see Appendix A). An expanded groundwater monitoring network is necessary to:

- Provide accurate data on the amount and rate of groundwater level changes;
- Provide groundwater withdrawers with timely and accurate information to effectively manage withdrawal activities;
- Establish the correlation between groundwater pumping and water level changes, both on the local and regional scale;
- Assess how climate variations impact groundwater levels; and
- Guide management efforts to minimize potential impairment of the aquifers and track progress in reversing water level declines.

A goal for the comprehensive groundwater monitoring network should be a complete coverage and network of wells for each aquifer in each of the SLCUA counties. Installation of wells in Kershaw County is especially critical, as this county has the fewest number of monitoring stations. Additional monitoring stations should also be installed at locations where heavy pumping is taking place. Additional actions to achieve this goal include the following:

- Cooperate with local, state, and federal partners to expand groundwater monitoring networks and sharing of well data;
- Promote partnerships in the state to identify wells that may be incorporated and of benefit to the well network; and
- Identify wells scheduled for abandonment that may be incorporated and of benefit to the well network.

Strategy #2: Identify Geographic Areas of Concern and Level/Reduce Pumping Where Appropriate

Prior to each permit renewal cycle, SC DHEC will consider the best available information on the geologic and hydrogeologic characteristics of the aquifer(s) and groundwater withdrawals of the area to protect against or abate unreasonable, or potentially unreasonable, adverse effects on the aquifer(s) and water users of the SLCUA. Measures that SC DHEC may require applicants, permit holders, and groundwater withdrawers to take may include, but not be limited to, the following:

- Utilize other available freshwater aquifers than those currently used;
- Utilize conjunctive use of aquifers, or waters of less desirable quality, where water quality of a specific character is not essential;
- Utilize conjunctive use of surface water when available;
- Utilize the groundwater model of the coastal plain aquifers that has been developed by the USGS and SC DNR to determine the potential for adverse effects;
- Prohibit the hydraulic connection of aquifers that could result in deterioration of water quality in freshwater aquifers;
- Implement abandonment of wells, which will be filled with cement grout, plugged, and sealed;
- Implement abandonment of wells that have penetrated zones of undesirable water quality where such wells are found to cause contamination of freshwater aquifers where undesirable water quality is defined as not meeting the standards for Class GB Waters as listed in *Water Classifications & Standards*, R.61-68.H.9;
- Implement construction and use of observation or monitoring wells;
- Implement reasonable and practical methods to conserve and protect the water resources and to avoid or minimize adverse effects of the quantity and quality of water available to persons whose water supply has been materially reduced or impaired as a result of groundwater withdrawals;
- Implement such other necessary and appropriate control or abatement techniques are technically feasible;
- Reduce/Level groundwater withdrawals in areas of concentrated pumping; and
- Reduce/Level groundwater withdrawals in areas where it is found to be in the public interest or general welfare, or to protect the water resource.

Strategy #3: Review Permit Applications Based on Demonstrated Reasonable Use

Proposed withdrawals will be evaluated considering reasonable use and need, aquifer(s) being utilized, potential adverse effects on adjacent groundwater withdrawers, previous reported water use, anticipated demand for the proposed activities, availability of alternate water sources, and reported water use at facilities with similar activities. Applications for groundwater withdrawal will incorporate a "Water Use Plan" or a "Best Management Strategy" detailing actual or proposed water use activities and all conservation techniques for site specific water management including, but not limited, to:

- Provide appropriate documentation that the proposed water use is a beneficial use of the resource and necessary to meet the reasonable needs of the applicant;
- Describe in detail the applications for which the water is being withdrawn and approximate quantities utilized in each application;
- Identify the aquifer(s) currently utilized and the hydrogeologic (groundwater quality, specific capacity/yield, etc.) factors for utilization, and if a less utilized aquifer is suitable to meet the facility's need;
- Identify additional or alternate sources of water, including surface water, effluent, or recycled water, among others, suitable to meet the needs of the applicant and supplement, minimize, or eliminate groundwater sources;
- Identify reasonable and appropriate conservation methods or practices that maximize efficiency of current water use and reduce current water demand; and
- Identify any existing or anticipated adverse effects on other groundwater withdrawers, including public use, and strategies to eliminate or minimize these effects.

Strategy #4: Establish an Educational Plan for the General Public and Existing Groundwater Withdrawers

General public, stakeholder, and permittee education outreach and awareness are a cornerstone to the development of successful water management strategies. SC DHEC will coordinate with the Stakeholder Workgroup and other appropriate partners to develop educational resources, strategies, and incentives for conservation. An effective water management educational plan should incorporate the following:

- Provide audience-based public education and outreach programs;
- Provide best available information on current systematic and industry-based standards;
- Engage with state and local governments;
- Establish and promote conservation measures through:
    1. Enhanced water use efficiency;
    2. Identification of water losses and establishment of corrective actions; and
    3. Preparation for water shortages and implementation of appropriate responses.

Strategy #5: Manage Through Regulation, Assessment, and Planning

The Groundwater Use and Reporting Act (R. 61-113) provides for regulation of water withdrawals in South Carolina. Groundwater regulation is necessary to conserve and protect these resources, prevent waste, and provide and maintain conditions which are conducive to the development and use of water resources. As data are developed on the groundwater resources of the designated Capacity Use Areas, the regulations will be reviewed to ensure adequate adherence to the legislative declaration of policy laid out in Title 49, Chapter 5-20. SC DHEC will try to provide clarification on the following that pertain to regulations:

- Providing information on other permitting departments such as agriculture, private wells, and drinking water;
- Providing information on exemptions, emergency withdrawals, and withdrawals exceeding permitted volumes;
- Showing users that there is no priority on groundwater withdrawal regulations based on type use or demand.

SC DNR is responsible for developing and updating the State Water Plan. A groundwater model of the Coastal Plain aquifers has been developed by the USGS and SC DNR. As ongoing results of the modeling effort and the updates to the State Water Plan become available, they will help inform potential regulatory and policy changes and will be incorporated into this GMP.

Strategy #6: Establish a Plan for Continual Stakeholder Engagement and Awareness of Groundwater Development

As part of the permitting process, stakeholder involvement, comment, and recommendations will be incorporated during the public comment period of the permit application. SC DHEC requires groundwater withdrawers to publish a public notice for one day in a newspaper of general circulation within the CUA in which the groundwater is to be withdrawn. SC DHEC additionally publishes public notices for the entirety of the 30-day public comment period on the Environmental Public Notices page of the official SC DHEC website. Continuous engagement with stakeholders and other interested persons is important to promote awareness of groundwater development and general education. An effective plan for continued engagement should incorporate the following:

- Maintain a Stakeholder Workgroup that is diverse in geographic and type-use representation to serve in an advisory role and as a partner for engagement withinthe SLCUA communities;
- Provide a Stakeholder Workgroup a forum for SC DHEC to present each quinquennial draft GMP Report, receive comments for consideration as the draft is finalized, and evaluate whether considerations are needed for an updated GMP and a reconvening of the Stakeholder Workgroup to do such; and
- Provide a Stakeholder Workgroup an annual update of permits, water use and conditions in the SLCUA.

Groundwater Management Plan Reports

Every five (5) years, total annual groundwater withdrawals will be compiled and compared to available aquifer potentiometric maps provided by SC DNR. The report will include the following information:

- Listing of all permitted withdrawers, permitted withdrawal limits, and average groundwater withdrawal;
- Evaluation of withdrawals by category and by aquifer; and
- Identification of the aquifer(s) and area(s) with observed and potential adverse effects and all withdrawers utilizing the aquifer(s).

Based on the information developed for the plan report, modifications of groundwater withdrawals in identified areas of concern will be reviewed, and subsequently the GMP may be amended. The report will also evaluate, as information is developed, estimated future groundwater declines from the projected withdrawal rates (developed by SC DNR). The final report and updated GMP will be shared with the stakeholders and the permit renewals will be issued consistent with the report and the plan.

Appendix A

Select South Carolina Department of Natural Resources Groundwater Monitoring Network Hydrographs across the Santee-Lynches Capacity Use Area Counties

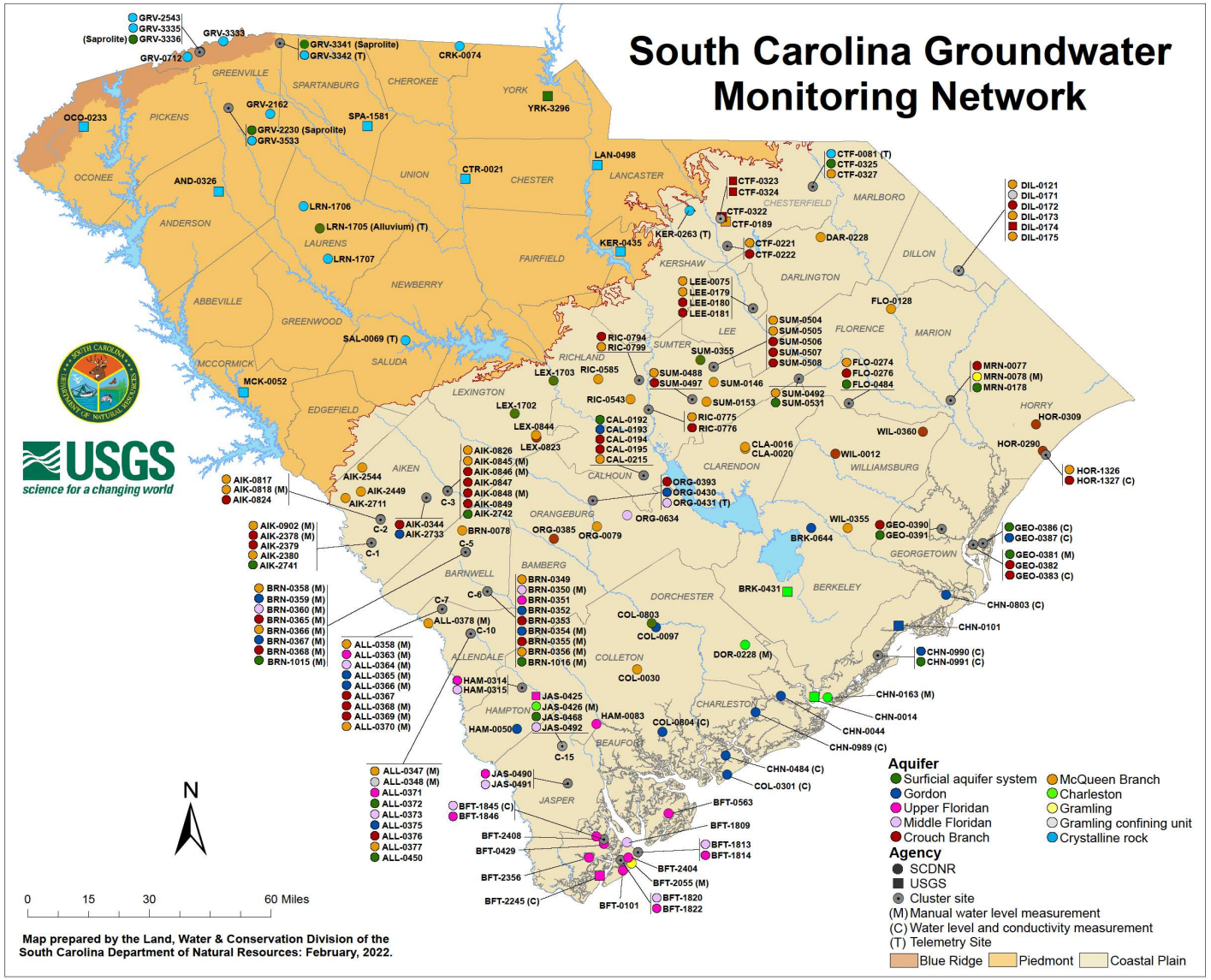


Figure 25. Map indicating the locations of the wells in the SC DNR groundwater monitoring network. The following pages contain the current hydrographs for selected SLCUA wells.

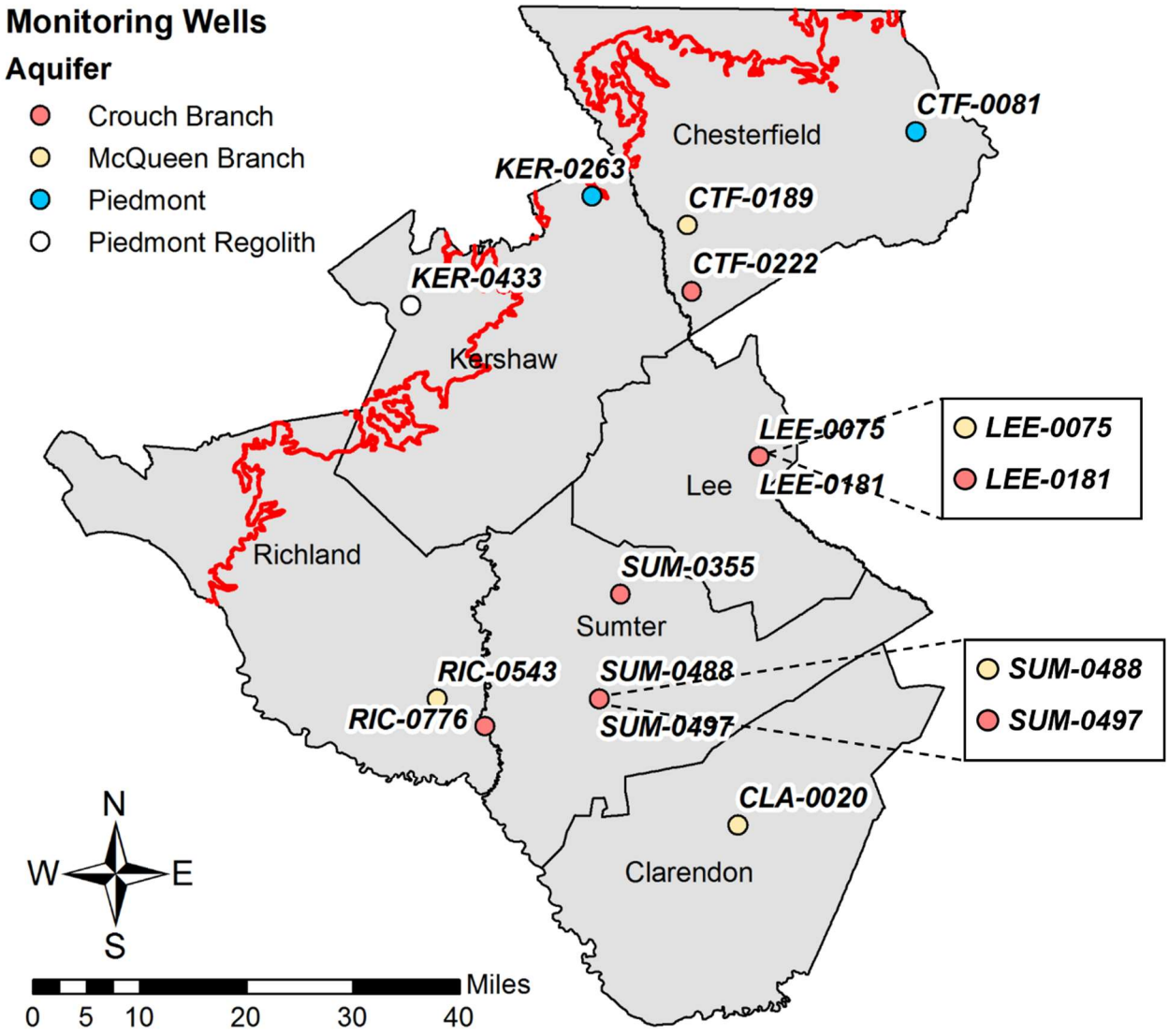
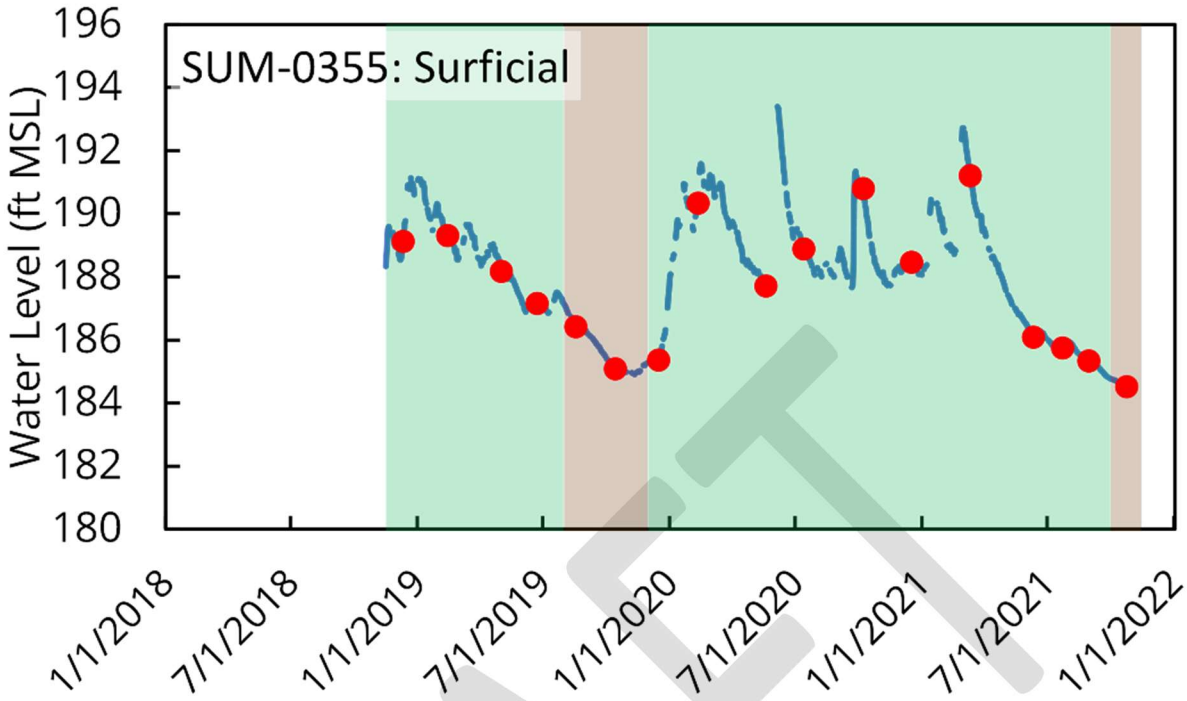
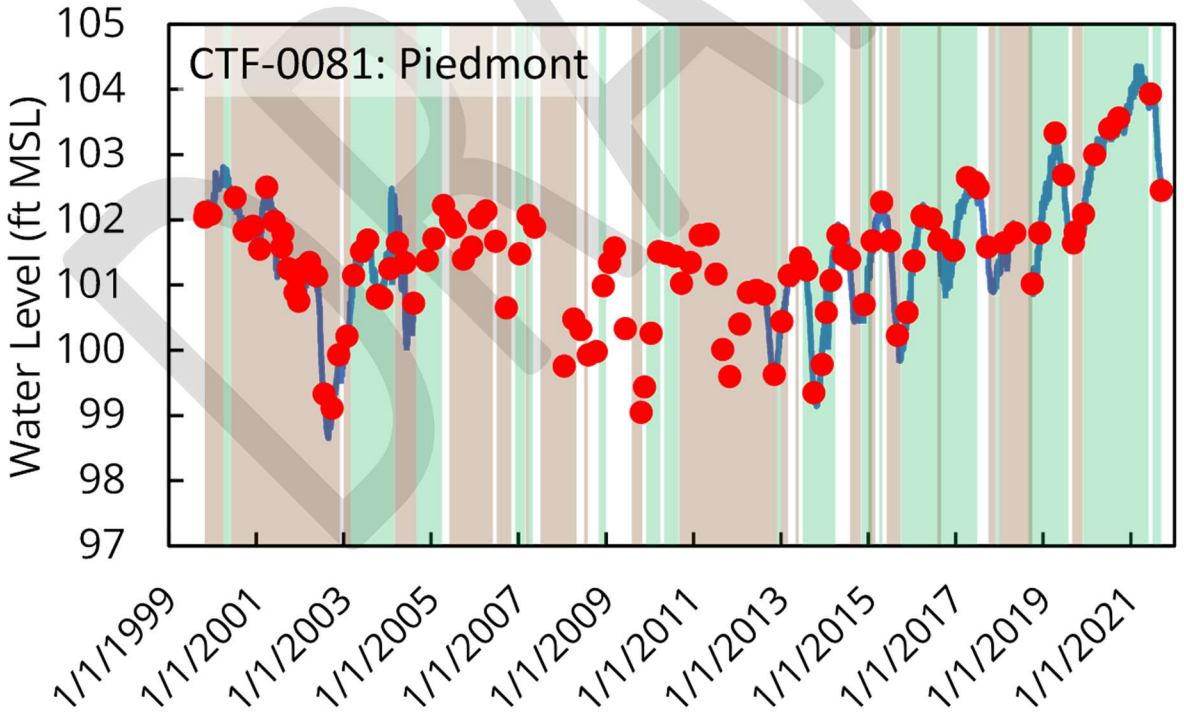
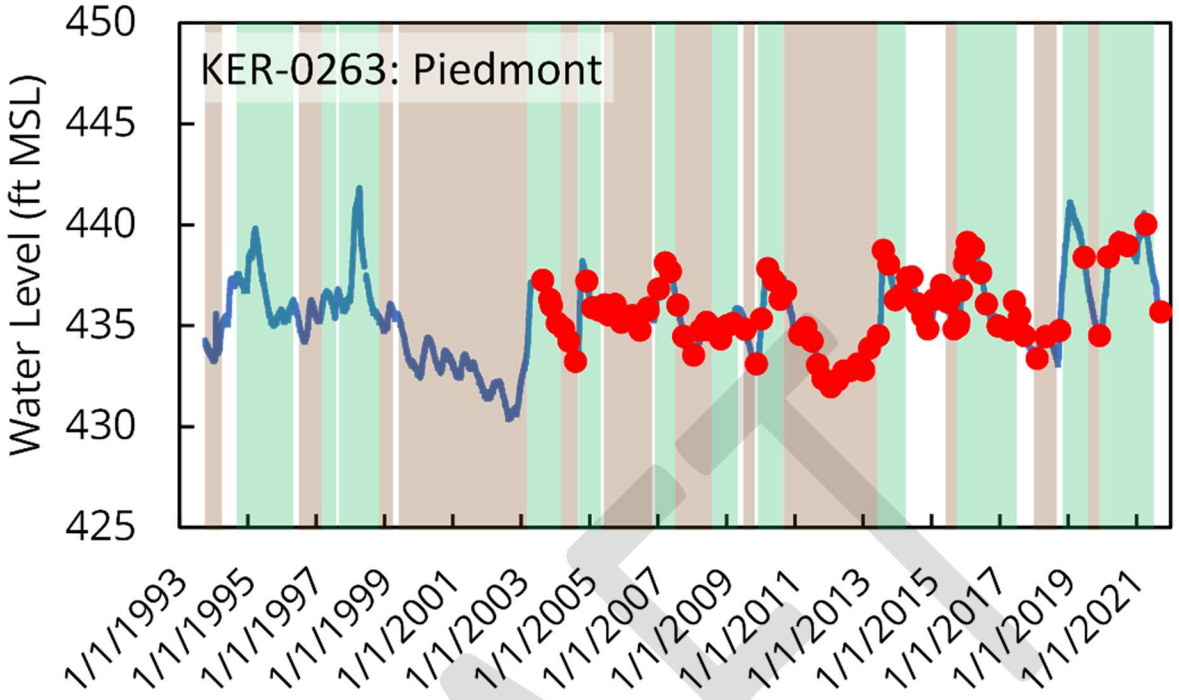
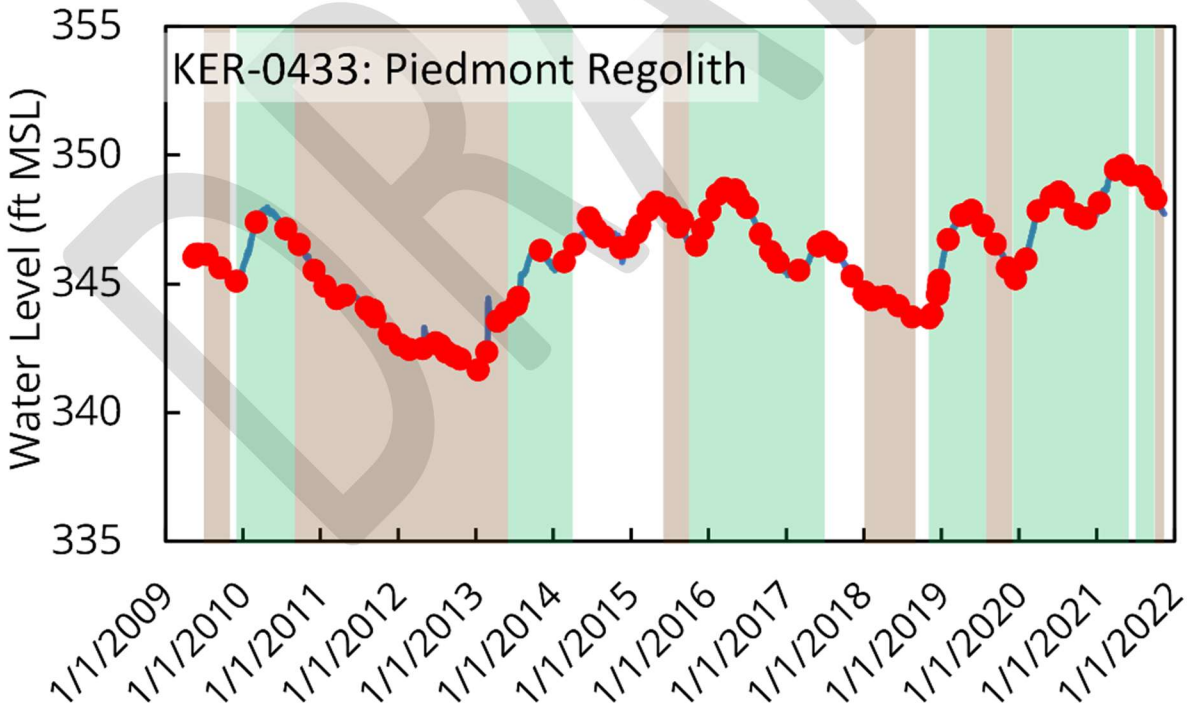


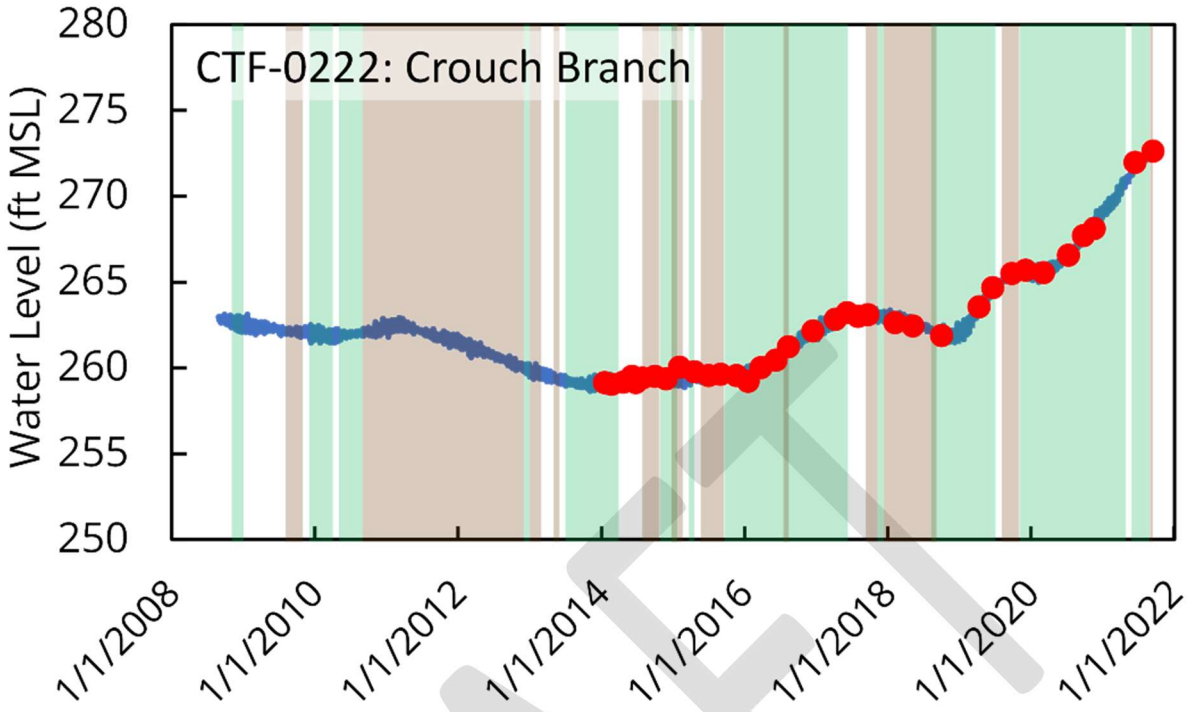
Figure 26: Select Monitoring Well Locations in the SLCUA. All wells are maintained by SC DNR except CTF-0189, KER-0433, and SUM-0355 which are maintained by the U.S. Geological Survey.

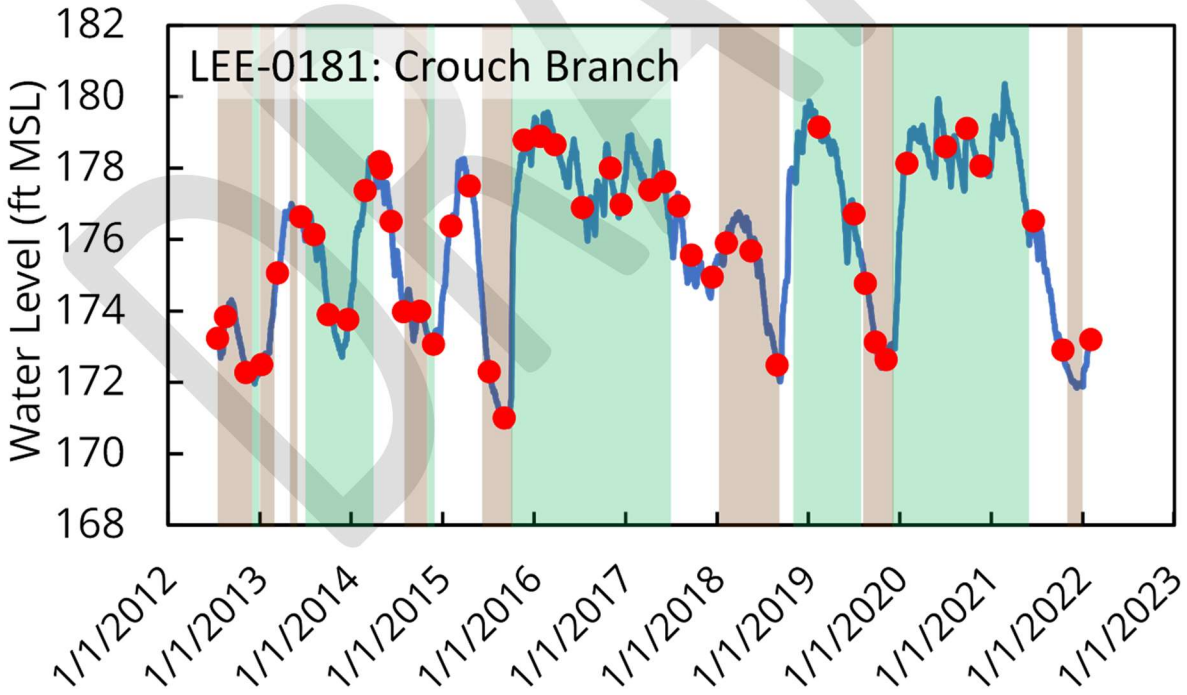

SUM-0355: Surficial
Water Level (ft MSL)
196
194
192
190
188
186
184
182
180
1/1/2018
7/1/2018
1/1/2019
7/1/2019
1/1/2020
7/1/2020
1/1/2021
7/1/2021
1/1/2022

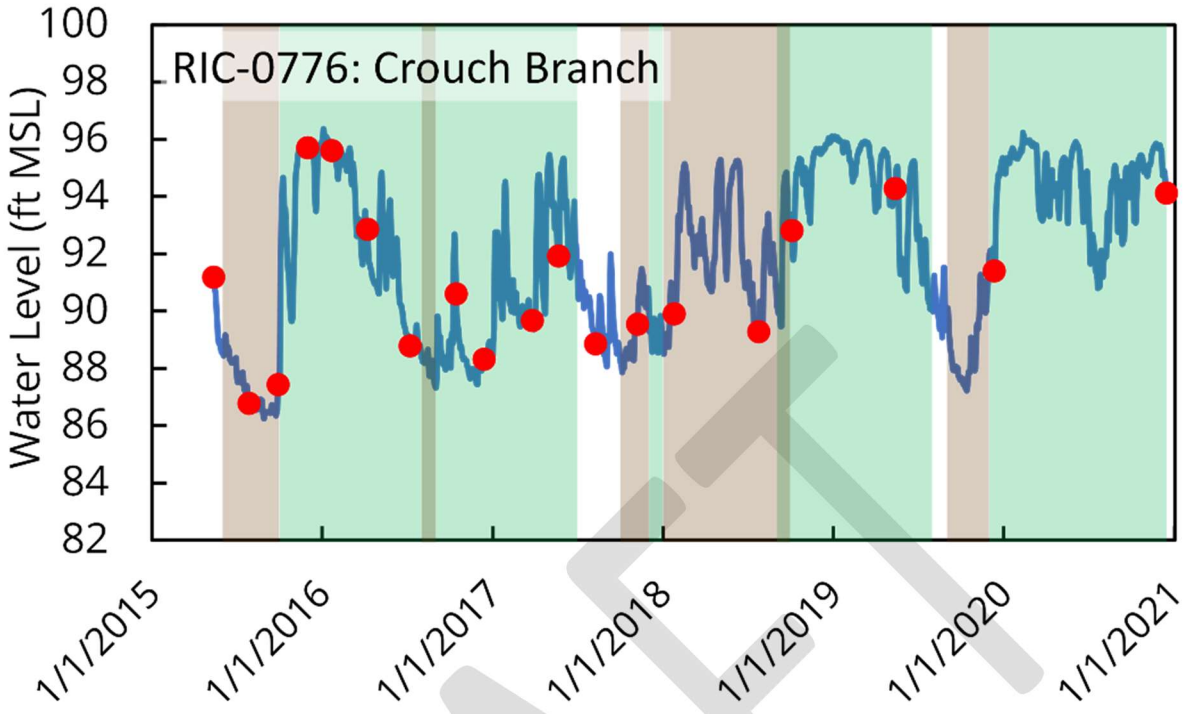

CTF-0081: Piedmont
Water Level (ft MSL)
105
104
103
102
101
100
99
98
97
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
1/1/2019
1/1/2021

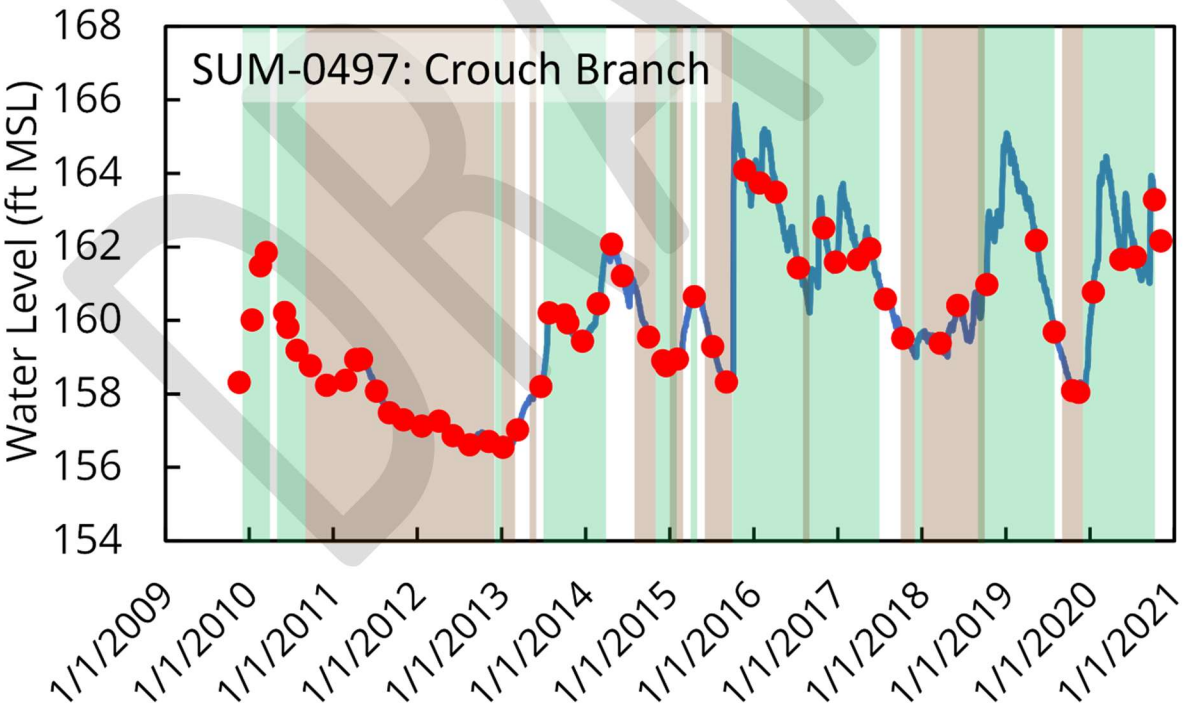

KER-0263: Piedmont
Water Level (ft MSL)
450
445
440
435
430
425
1/1/1993
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
1/1/2019
1/1/2021

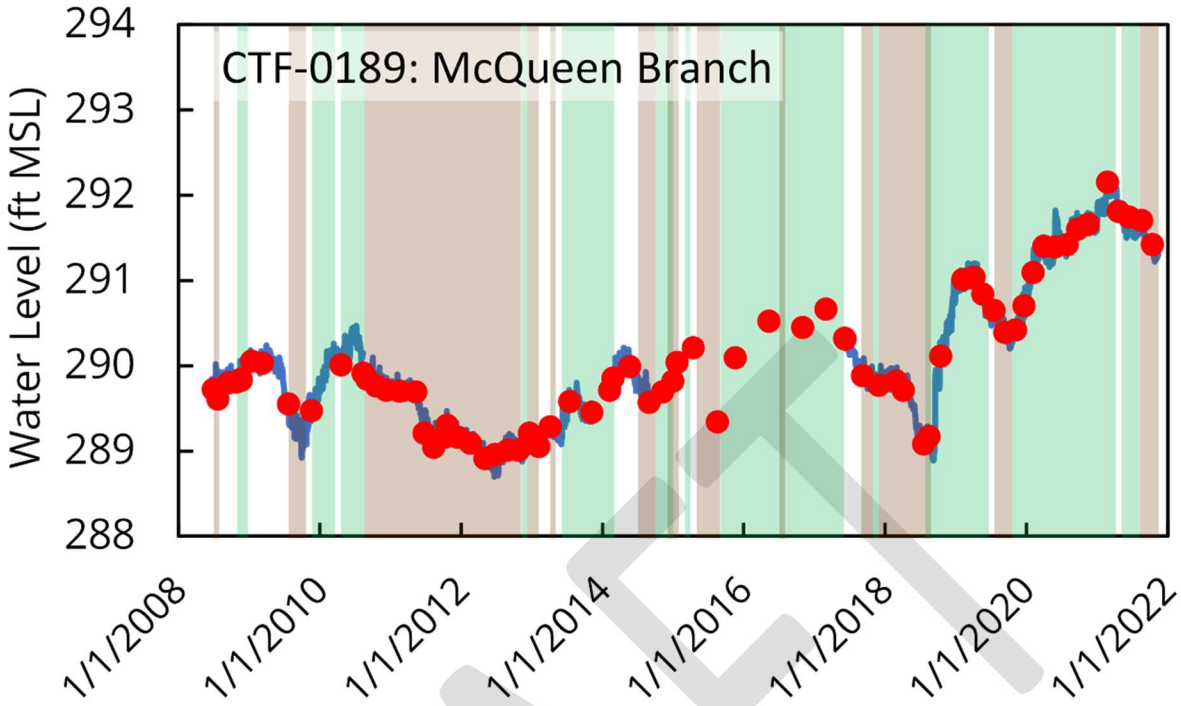

KER-0433: Piedmont Regolith
Water Level (ft MSL)
355
350
345
340
335
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021
1/1/2022

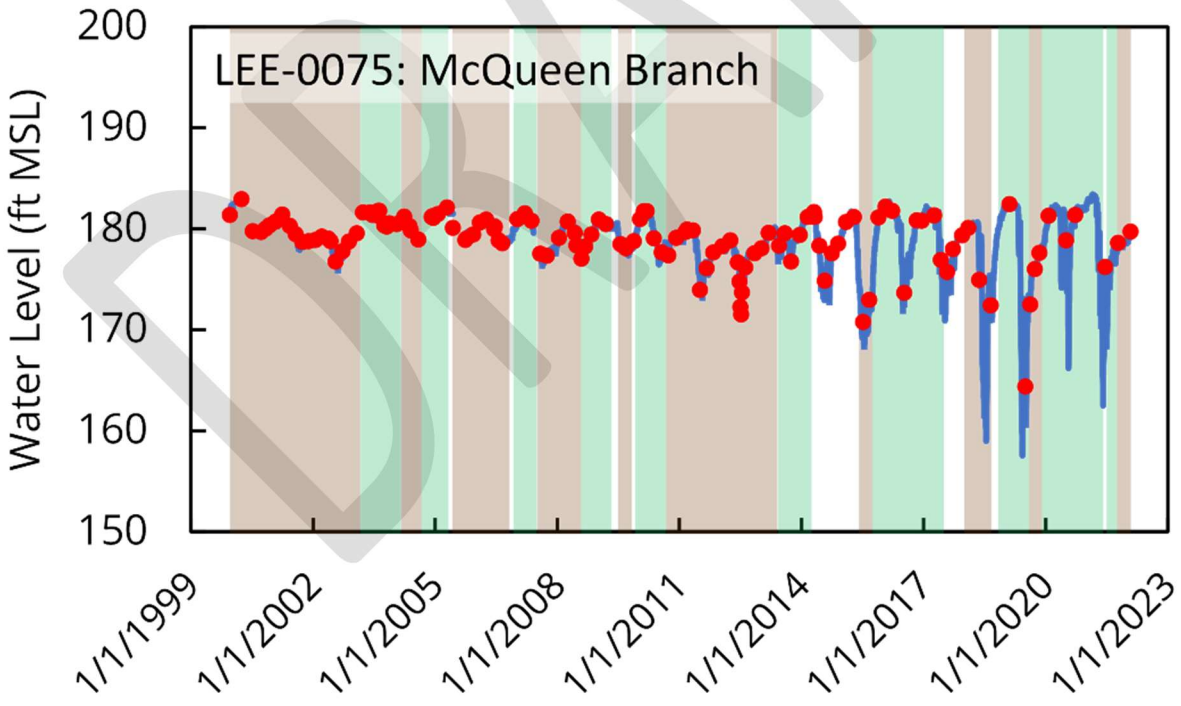

CTF-0222: Crouch Branch
Water Level (ft MSL)
280
275
270
265
260
255
250
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
1/1/2022

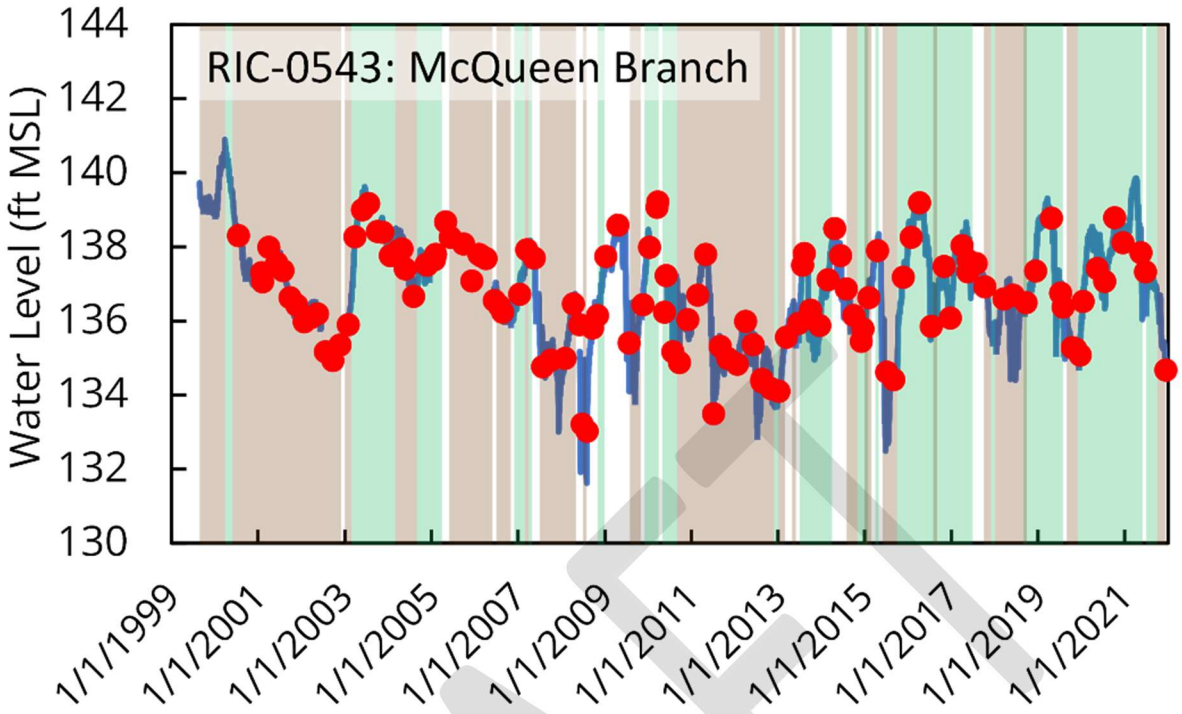

LEE-0181: Crouch Branch
Water Level (ft MSL)
182
180
178
176
174
172
170
168
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021
1/1/2022
1/1/2023

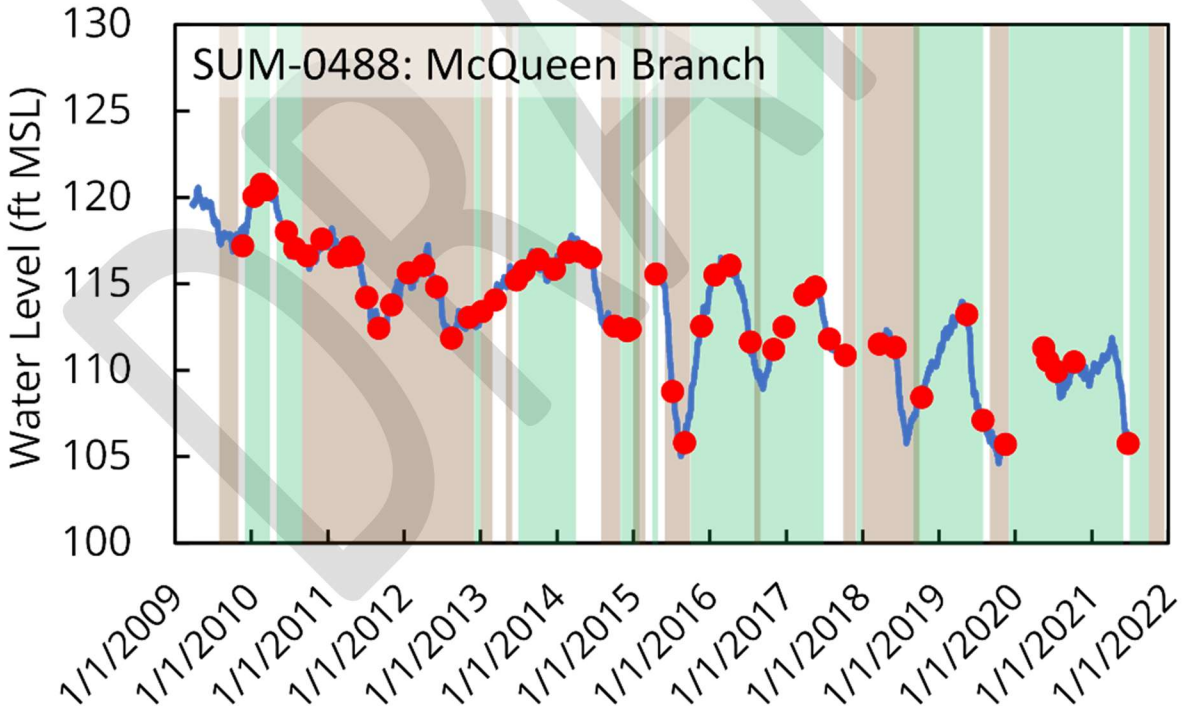

RIC-0776: Crouch Branch
Water Level (ft MSL)
100
98
96
94
92
90
88
86
84
82
1/1/2015
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021


SUM-0497: Crouch Branch
Water Level (ft MSL)
168
166
164
162
160
158
156
154
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021


CTF-0189: McQueen Branch
Water Level (ft MSL)
294
293
292
291
290
289
288
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
1/1/2018
1/1/2020
1/1/2022


LEE-0075: McQueen Branch
Water Level (ft MSL)
200
190
180
170
160
150
1/1/1999
1/1/2002
1/1/2005
1/1/2008
1/1/2011
1/1/2014
1/1/2017
1/1/2020
1/1/2023


RIC-0543: McQueen Branch
Water Level (ft MSL)
144
142
140
138
136
134
132
130
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
1/1/2019
1/1/2021


SUM-0488: McQueen Branch
Water Level (ft MSL)
130
125
120
115
110
105
100
1/1/2009
1/1/2010
1/1/2011
1/1/2012
1/1/2013
1/1/2014
1/1/2015
1/1/2016
1/1/2017
1/1/2018
1/1/2019
1/1/2020
1/1/2021
1/1/2022

Appendix B

Potentiometric Maps
Santee-Lynches Capacity Use Area Counties

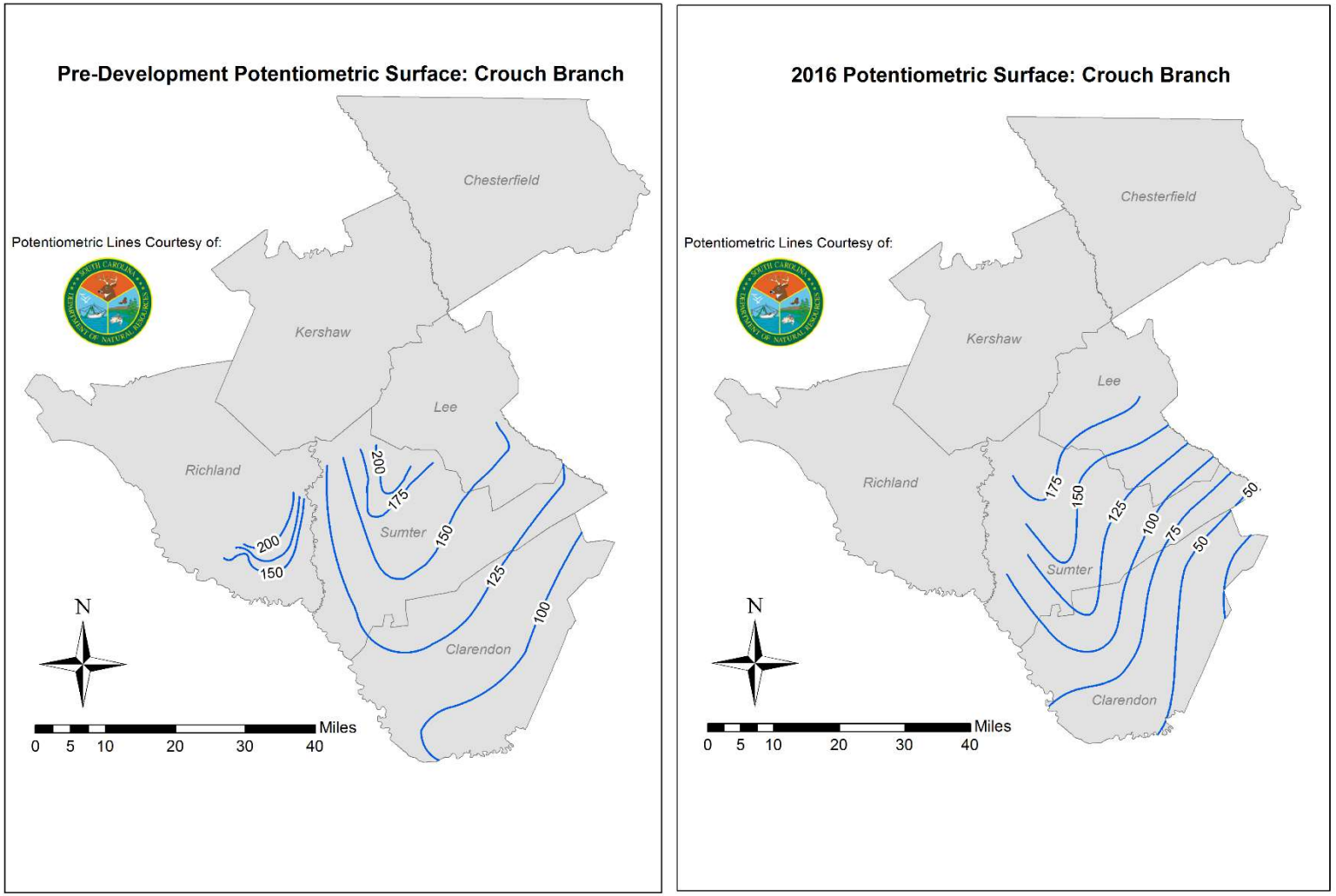


Figure 27: Potentiometric Maps of the Crouch Branch Aquifer Pre-Development (left) and 2016 (right)

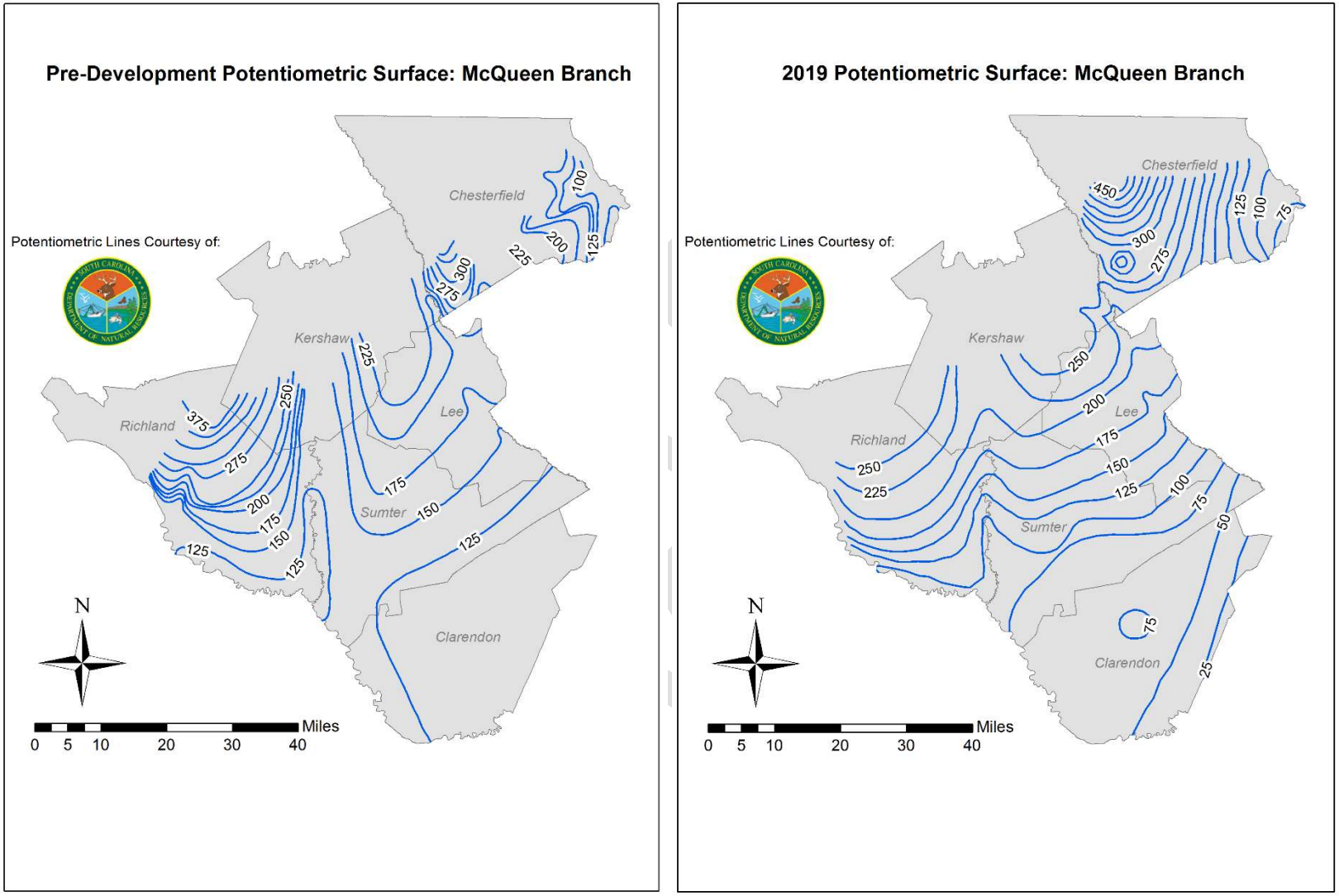


Figure 28: Potentiometric Maps of the McQueen Branch Aquifer Pre-Development (left) and 2019 (right)